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STRAITS SETTLEMENTS

Annual Report of the Director of Gardens, for the year 1935

BY

R. E. HOLTTUM, M.A., F.L.S.,
Director of Gardens, S.S.

Published by Authority

SINGAPORE:
PRINTED AT THE GOVERNMENT PRINTING OFFICE, SINGAPORE
BY W. T. CHERRY, GOVERNMENT PRINTER.

1936

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ANNUAL REPORT OF THE DIRECTOR OF GARDENS, STRAITS SETTLEMENTS, FOR THE YEAR 1935

By R. E. HOLTTUM, M.A., F.L.S., *Director of Gardens, S.S.*

STAFF

The only change in the European staff of the Department was caused by the retirement of Mr. J. LENNON, which became effective on May 13th after leave dating from September 12th, 1934. Mr. LENNON completed thirteen years of conscientious service in the post of Assistant Curator, Parks, Singapore. He was succeeded by Mr. J. C. NAUEN, who was transferred from Bermuda, and arrived in Singapore on August 3rd. Among the local staff, Queh Ah Hoon, Engine Driver and Carpenter, retired at the age limit on March 31st after 24 years of faithful and valuable service; Wong Siew Hang assumed duty as Foreman Gardener, Government House Domain, on February 11th, in place of Jabawaladoss.

LABOUR

The average number of gardeners and coolies remained about the same, 84 at Singapore, and 52 at Penang. Five cases of Malaria were reported at Penang and two in Singapore; the health of the staff was otherwise good. One of the older Javanese gardeners in Singapore died suddenly at an age of about 60 years. There were few changes in the personnel of the labour force. The minimum wage at Singapore was 47 cents and at Penang 45 cents a day.

REVENUE

The revenue from the sale of plants, etc. was as follows:—

		$	c.
Singapore:—			
Sale of plants and seeds	..	*1,809	58
Inspection fees, etc. ..	..	118	00
Penang:—			
Sale of plants and seeds	..	396	97
Sale of guides ..	..	13	08

In addition to the above, the Municipal Commissioners at both Singapore and Penang contributed $100 monthly, as in former years, for the services of Gardens officers in connection with the planting and maintenance of roadside trees, etc.

PLANT COLLECTIONS AND FIELD EXCURSIONS

Mr. CORNER continued his investigation of the fresh-water swamp forest of eastern Johore. Two short excursions were made to collect along the new Jemaluang Road, from 1st to 10th February and 10th to 15th May, and special thanks are due to Mr. AH LEK of Borneo Motors, Ltd. who gave Mr. CORNER the hospitality of his house at Kota Tinggi on each occasion. Mr. CORNER paid shorter visits to the Mawai district on several other occasions. Thanks are due to the Conservator of Forests, Johore, for his most helpful co-operation in the explorations, and to Mr. H. G. GRIEVE of Tebrau Estate for hospitality. The Mawai district continues to yield many new and little known plants of all kinds. Among these may be mentioned *Tetractomia Holttumii* (previously known only on the summit of Gunong Belumut), *Endiandra Holttumii* (once found previously, in Pahang), *Stichoneuron caudatum* (previously known only from the main range in Perak), *Cephalomappa penangensis* (only known previously from a collection of Curtis from Penang), *Viscum Wrayi* (a rare mistletoe only known on mountains in the north), *Madhuca hirtifolia* (previously collected only once, in Perak), *Blumeodendron Kurzii* and *Cryptocarya cinnamonifolia* (not previously found in the Peninsula), and a species of *Gyrinopsis*, a genus allied to Aquilaria (which yields the incense-wood *kayu gaharu*), not previously known in the Peninsula. Several other probable new species have also been found, and the whole collections need studying in comparison with Bornean specimens. The flora of this part of Johore has much in common with that of Sarawak.

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* The value of the dollar is approximately 2*s*. 4*d*.

Mr. CORNER made an expedition to the east coast of Pahang, in company with Mr. W. BIRTWISTLE (Officer in Charge, Fisheries Department), in August. The District Officer, Kuantan, kindly lent the launch *Sri Pekan* for the occasion. The expedition started from Mersing to Pulau Tioman, and then proceeded gradually along the Pahang coast from Pontian to Kuantan. Botanical work was rather restricted by the "Tenggara", (S. E. monsoon) which caused each afternoon a heavy swell from the S. E. and made landing and taking off from the shore impossible on most days after noon. Nevertheless Mr. CORNER managed to study fully the vegetation of the small islands Pulau Tukong Burong, P. Rengis, P. Chibeh, P. Sepoi, P. Labas and P. Duchong Laut, together with part of P. Tulai, Tanjong Ruit on the east of Tioman, and P. Setindan near Mersing. The flora of these islets is interesting on account of their geological differences, their exposure to the N. E. monsoon and the nesting of sea-birds. Mr. CORNER also completed some studies begun last year on the sea-shore vegetation of Pahang. Among the plants on the small islands, the most remarkable is *Chrysopogon collinus* Ridl., a rare grass collected only once before, in Setul. This grass formed the only vegetation on P. Tukong Burong, growing among the numerous nests of the terns.

From 29th October to 1st December, Mr. CORNER went to Bukit Kajang, Kemaman, and stayed at Mr. E. P. SWANN'S tin mine. A small area of forest was cleared under Mr. CORNER'S supervision, and this gave an excellent idea of the local flora, which is extraordinarily rich and distinctly different from that of other parts of the Peninsula. The weather was wet, but a large number of trees and shrubs were in flower or fruit, so that a big collection, comprising many new species, was obtained. Among the most interesting discoveries were the true mangosteen growing wild in high forest, a parasitic Hoya with the habit of a mistletoe, a geocarpic palm, a new Morinda, and a Habenaria new to the flora of the Peninsula. Most of the wild gingers and many of the Gesneraceous herbs in the district appear to be new or very little known. Grateful thanks are expressed to Mr. SWANN for his hospitality and to the Assistant Adviser, Kemaman, for his assistance and for arranging for the services of a forest guard to be at Mr. CORNER'S disposal.

Mr. M. R. HENDERSON visited Kelantan in July. The Sungei Lebir (river) was ascended as far as the large shale ridge Bukit Batu Papan, and collections were made here and on the banks of one or two of the smaller streams in the neighbourhood. A number of interesting plants were obtained here, including a Begonia which appears to be new to the Peninsula flora. Kuala Betis, on the Nenggiri River, was next visited, and collections were made on the track between here and Gua Musang. A group of small limestone hills a few miles up the S. Betis was visited, and one of them, Gua Teja, was climbed. Fortunately, a large proportion of the small trees and shrubs on the summit of this hill were found in flower or fruit, a rather unusual occurrence on this type of limestone hill. Collections were also made round the base of Gua Lambok, another limestone hill in the vicinity. Thanks are due to the District Officer, Ulu Kelantan, for much assistance to Mr. HENDERSON during this expedition.

While on leave in Java in April, Mr. HENDERSON was enabled, through the courtesy of Dr. DAMMERMAN, Director of the Botanic Gardens, Buitenzorg, and Dr. VAN STEENIS, Acting Chief of the Herbarium, to visit many places of botanical interest in West Java, including primary forest on limestone near Buitenzorg, the Mountain Garden at Tjibodas and the extremely interesting "tegals" or grass plains on the volcano Mount Papandajan. Some time was also spent in the herbarium at Buitenzorg.

HERBARIUM WORK AND OTHER INVESTIGATIONS

Mr. HENDERSON carried on the usual routine herbarium work and all collections made during the year, with the exception of Mr. CORNER'S from Kemaman, were dealt with. Further progress was made in the preparation of a list of the plants growing upon limestone in the Peninsula. Mr. HENDERSON has now visited most of the limestone districts, and has acquired a considerable knowledge of the peculiar flora. Valuable collections amounting to over 1,000 numbers, were received from the Conservator of Forests, B. N. Borneo. These were sent unnamed, and preliminary identifications were made as far as the resources of the Herbarium permitted.

New exchange relations were opened with Prof. H. H. BARTLETT of the University of Michigan. Prof. BARTLETT maintains a native collector in Sumatra, and as the Singapore herbarium is deficient in material from that island, this exchange should prove exceedingly valuable. A new exchange was also begun with Lingnan University, Canton, with the object of acquiring southern Chinese material.

Thanks are due to the staff of the Herbarium of the Royal Botanic Gardens, Kew, for help in the naming of difficult and critical material during the year; to Mr. G. F. SYMINGTON for naming Dipterocarpaceæ; and to Dr. VAN STEENIS for help in giving his opinion on various plants sent to him from time to time.

Duplicate herbarium specimens were distributed in 1935 as follows:—

Royal Botanic Gardens, Kew	1,061
Forest Research Institute, Kepong ..	631
Botanic Gardens, Buitenzorg, Java ..	388
Bureau of Science, Manila	277

Lingnan University, Canton	163
Arnold Arboretum, U.S.A.	146
H. H. Bartlett, University of Michigan, U.S.A.	145
Imperial Forestry Institute, Oxford	142
Sun Yatsen University, Canton	138
Taihoku Imperial University, Taiwan	62
Botanic Gardens, Berlin (Palms)	41
Total	3,194

Timber specimens distributed:—

Sun Yatsen University, Canton	24
Forest Research Institute, Kepong	20
Botanic Gardens, Buitenzorg, Java	12
Royal Botanic Gardens, Kew	7
Imperial Forestry Institute, Oxford	2
Total	65

The following herbarium material was lent for study to other persons and institutions during 1935:—

Dr. C. G. G. J. van Steenis, Buitenzorg, Java *(Aceraceae, Salicaceae, Cochlospermaceae, Stackhousiaceae, Linaceae, Valerianaceae Datiscaceae)*	122
Miss Imlay, Kew (Siamese *Acanthaceae)*	120
Dr. A. F. G. Kerr, Kew (Siamese *Apocynaceae* and *Asclepiadaceae)*	119
Dr. Fletcher, Edinburgh (Siamese *Verbenaceae)*	65
Botanic Gardens, Buitenzorg	46
Forest Research Institute, Kepong	25
Arne Hassler, Lund, Sweden *(Euphorbia Atoto)*	25
Miss Barnett, Aberdeen (Siamese *Cupuliferae)*	17
Royal Botanic Gardens, Kew	14
Dr. H. J. Lam, Leiden (Oreiostachys)	3
Total	556

The following herbarium specimens were received:—

Forest Department, British North Borneo	1,095
Forest Research Institute, Kepong	583
Dr. E. D. Merrill, New York (Bornean & Kweichow plants)	424
H. H. Bartlett, University of Michigan (Sumatran plants)	135
Lingnan University, Canton	107
Bureau of Science, Manila	106
Government Botanist, Brisbane, Australia	96
Arnold Arboretum, U.S.A.	94
Dr. O. Posthumus, Java (Flores plants)	5
Total	2,645

The following collections were purchased:—

Mr. B. A. KRUKOFF'S Sumatran plants ..	377 specimens
Mr. C. E. CARR'S Papuan plants ..	1,300 specimens

The number of sheets mounted in 1935 was as follows:—

Local collections and Gardens Herbarium ..	1,219
Specimens received in exchange or purchased ..	1,821
Total ..	3,040

Mr. FURTADO has continued his work on Malayan palms, devoting himself chiefly to certain groups of rattans. These very difficult groups have been in a state of much confusion, and progress has been slow. The loan of some of Griffith's types from Calcutta, for which we are grateful, has been of value in this work, and the Forest Department have lent specimens from the Kepong Herbarium. Mr. FURTADO has put into order the section *Piptospathae* of the genus Dæmonorops, and has made considerable progress with the remaining section *Cymbospathae*. The results involve some changes in the botanical names of the half-dozen species producing Dragon's Blood, and a revision of the distribution of the species. Further comparisons with specimens from Borneo and Sumatra will be required before a full account of the whole genus can be published, as there is doubtless some further overlapping of names, which may involve changes in the accepted names of the Peninsula species. Mr. FURTADO will next deal with the genus Calamus in the same way; this will be a much larger task, but it is hoped that it will be completed in time. The rattans are of considerable commercial importance, and it is obviously desirable to have them properly classified botanically. They constitute a large group of closely allied species, superficially very similar, and requiring careful study to discriminate. The collection of specimens of the very thorny leaves and inflorescences is an unpleasant business, and the specimens themselves are awkward to handle in the herbarium. Collectors often have not realised which are the important parts of the plant for identification purposes, and specimens are thus frequently inadequate. For mounting in the herbarium, leaves and other parts have often to be cut into pieces, and these pieces are easily mixed, so that parts of two different plants may be mounted together as from the same collection. All these factors have made for confusion.

Mr. FURTADO also elaborated some notes on Malayan Calami made during his work in European herbaria in 1933–34, and published the same; he further dealt in a similar way with some species of Aroids from the Peninsula.

Mr. FURTADO continued to have charge of the herbarium of cultivated plants. In the naming of palms, he was much assisted by Capt. H. A. JOHNSTONE, who spent about three weeks in Singapore in the early part of the year. Capt. JOHNSTONE has studied the palms growing in all the principal botanic gardens throughout the world, and placed at our disposal the results of his observations. This has resulted in many corrections in the names of our plants. Capt. JOHNSTONE also made a very careful series of photographs of most of the palms in our Gardens, and presented us with a set of prints, which will be of great value for future reference. We are most grateful to him for all his help, and also for the presentation of a valuable book on palms (acknowledged below).

A note on a palm which flowered in March, 1935 illustrates some of the difficulties of correctly naming exotic plants cultivated in the Gardens. The palm is a Livistona, on lawn B, near the main gate. It has flowered and fruited several times, at intervals of a few years; perhaps only when there is an unusually dry season. Though it is rather similar to *L. rotundifolia*, the commonest Livistona in gardens in Singapore, it differs somewhat in habit, and the orange-red fruits are larger. There is no record of the origin of the plant. It was at first thought that it might be *L. Mariae*, from Australia; but it appears more probably to be *L. Robinsoniana* from the Philippines, seeds of which were introduced from Negros in 1909. If a record of the origin of the plant had been kept, the determination of its correct name would have been much simplified. All woody plants now planted out in the Gardens are recorded on a card index with a reference to the accession register, so that the origin and date of planting can be ascertained.

Mr. E. J. H. CORNER continued his investigations of the larger fungi, but most of his time was spent on other work. At the request of the Inspector of Schools, Mr. CORNER conducted a series of twenty evening classes on Malayan Plant Life for teachers in Singapore schools. This course was very successful, and those taking part showed considerable interest. In connection with the classes, Mr. CORNER made a number of investigations of common local plants, and prepared a quantity of notes, drawings and photographs which it is hoped to use in a series of publications of a popular and semi-popular nature on local plants. In particular, Mr. CORNER investigated the seedling stages of a number of different plants, showing a surprising variety of development. He prepared a large series of excellent drawings, which it is hoped to publish; the information will not only be an interesting addition to botanical knowledge, but will also be an introduction to Malayan plant biology suitable for local residents. It is hoped to treat similarly other aspects of plant biology. Mr. CORNER also made a very fine series of photographs of the leaves, flowers and fruits of common local trees, and prepared notes for a popular work on the subject which it is hoped to publish in 1937.

The Director prepared a paper on the tree-ferns of the Malay Peninsula, of which there are 16 species; a small number in comparison with Sumatra and Borneo. Since the paper was published another species has been recognised at Penang, closely allied to the common lowland tree-fern *Cyathea latebrosa* but distinct. The distinction is most notable in the bases of the stipes, a feature often lacking in herbarium specimens; this again illustrates the necessity for field observation for a full knowledge of plants. The Director also began a study of the genus Lomagramma, an interesting group of climbing ferns; specimens from the herbaria at Buitenzorg and Manila were borrowed, to enable the study to be made as complete as possible. A chapter on the Ecology of Pteridophytes was also prepared for a general work on pteridophytes edited by Dr. VERDOORN of Leiden.

The Director continued his experimental cultivation of hybrid orchid seedlings, with the assistance of Mr. J. L. PESTANA, Laboratory Assistant. Methods remained the same, and a report on the plants raised is given under the heading "Botanic Gardens, Singapore". The Director made some experiments in the propagation of plants from cuttings in a medium of coir dust, in a closed frame, by a similar method to that used at the Royal Botanic Gardens, Edinburgh. The method was successful with cuttings of *Camoensia maxima, Brownea grandiceps* and other species which do not usually produce seeds and are difficult to propagate by ordinary methods; for some other plants it was not successful. Cuttings will remain in fresh condition without wilting for weeks. The Director also continued his observations on the periodic leaf-change and flowering of trees; the records in some cases are complete from 1927, and provide a very interesting series of data which it is hoped to publish soon.

The Gardens Library.—Mr. FURTADO continued in charge of the Library, and also continued the card indexes (i) of current literature relating to Malayan plants and (ii) of new species from the Malay Peninsula and corrections to Ridley's Flora. The number of additions to the library has been considerable in recent years, and the accommodation is rapidly becoming inadequate. A certain amount of additional room has been secured by handing over certain periodicals of a purely agricultural nature to the Department of Agriculture. The number of periodicals received is now 126, mostly in exchange for the *Gardens' Bulletin.* Exchange with a certain number of purely agricultural periodicals has been stopped.

The number of books bound during the year at the Government Printing Office was 165. Assistance was also received from the Printing Office staff in poisoning the books in the library; this valuable help is gratefully acknowledged.

Captain H. A. JOHNSTONE presented to the library a copy of a valuable illustrated work on palms from tropical America: *Sertum Palmarum Brasiliensium,* by J. BARBOSA RODRIGUES (Brussels, 1903, 2 vols. quarto, with folio illustrations). Grateful thanks are offered to Capt. JOHNSTONE for this munificent gift.

PUBLICATIONS

The Gardens' Bulletin, S.S.—A record number of four parts of the Bulletin were issued during the year. The contents were as follows:—

Vol. VIII part 2, Jan. 26th.—More than half this issue is occupied by a paper by Mr. C. E. CARR on orchids from Sarawak. There are also short papers by Dr. E. D. MERRIL and Messrs. CORNER and FURTADO, the latter contributing critical notes on Malayan Aroids and Palms, the results of work in European herbaria in 1933–34.

Vol. VII part 3, June 24th.—This contains a paper by Mr. C. E. CARR on orchid collections made by him on Mount Kinabalu for the Gardens Department in 1933, and by the Clemens expedition in 1931–33; a paper of critical notes

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on Malaysian rattans by C. X. FURTADO; and a description of a new Rhododendron from Gunong Tahan, by Dr. J. J. SMITH.

Vol. VIII part 4, October 28th.—This consists of four papers: Notes on Malayan Dipterocarpaceae, by Mr. C. F. SYMINGTON (Forest Research Institute, Kepong); The Tree-ferns of the Malay Peninsula, by R. E. HOLTTUM; Palmae Malesicae IV & V, by Mr. C. X. FURTADO.

Vol. IX part 1, 20th December.—This part was rather hastily prepared to commemorate the 80th birthday of Mr. H N. RIDLEY, Director of Gardens from 1888 to 1911. It contains a portrait and bibliography of Mr. RIDLEY'S publications (more than 500 items), and short papers by botanists from Malaya, the Netherlands Indies, Holland and the United States. The papers are all concerned with Malayan botany.

In addition, the following papers were contributed by members of the Gardens staff to other periodicals:—

Lightning Injuries to trees, by C. X. FURTADO (Journ. Malayan Branch, R. Asiatic Society XIII, pp. 157–162).

A disease of the Angsana tree, by C. X. FURTADO (ibid. pp. 163–192).

Observations on Resistance to Powdery Mildews, by E. J. H. CORNER (New Phytologist 34, pp. 180–200).

The Fungi of Wicken Fen, Cambridgeshire, by E. J. H. CORNER (Trans. British Mycological Society 19, pp. 280–287).

The Director continued to edit the horticultural section of the M. A. H. A. MAGAZINE, and contributed articles to each issue; articles were also contributed by Mr. F. FLIPPANCE and Mr. E. J. H. CORNER, the latter's contribution being a very useful survey of the species of the genus Cassia growing in Malaya.

The Director contributed several articles to the Malayan Orchid Review, Vol. 2, No. 2, including a description of the species and varieties of "Scorpion" Orchids (Arachnis), and of a new hybrid Phalaenopsis.

PLANTS OUTWARDS AND INWARDS

OUTWARDS:—

Singapore—

Plants sold	3,343
Cannas sold	2,106
Cuttings, bulbs, etc. sold	6,655
Seeds sold	155 packets
Plants sent on exchange	148
Plants supplied free	1,096
Seeds supplied to other Botanical Institutions	1,108 packets

Penang—

Plants, etc. sold	4,178	
Seeds sold	43	packets
Supplied free or in exchange:		
Plants	1,286	
Seeds	15	packets
Tubers	728	
Cuttings	618	

Inwards:—

Singapore—

Plants collected by staff	205	
Seeds collected by staff	89	packets
Plants, etc. received as gifts or in exchange	618	
Seeds and bulbs received as exchange	454	packets
Plants purchased	154	
Seeds purchased	280	packets

Penang—

Received as gifts or in exchange:		
Plants	413	
Seeds	479	packets
Bulbs	752	

The gift of plants and seeds from the following is gratefully acknowledged:—

Singapore.—Mrs. Bain (Johore), Mr. J. G. Barraclough (Pahang), Mrs. Beatty (Malacca), Sir Andrew Caldecott, Mrs. Clemens (New Guinea), Mr. J. A. le Doux (Johore), Mrs. Gibson, Dr. G. A. C. Herklots (Hong Kong), Mr. J. M. Jackson, Mr. H. L. Jeppesen (Johore), Mr. B. J. P. Joaquim (Kuala Lumpur), Captain H. A. Johnstone, Mrs. W. L. Legg, Mr. Maxon, Mr. G. R. Mills (Batu Gajah), Mr. J. C. Nauen (Bermuda), Mr. J. R. Pyper, Mr. W. N. C. Steele (Gemas), Mr. Z. Teruya, Phra Maha Vichai (Bangkok), Mr. C. F. F. Wearne (Cameron's Highlands), Rev. Nigel Williams (Taiping), the Agricultural Field Officers, Singapore, and Telok Anson, and the Agricultural Chemist (varieties of Derris), the Forest Officer, Dindings.

Penang.—Mr. G. S. Hooper (orchids), Mr. A. W. Hughes (Begonia), Mr. A. C. McLeod (orchids), Mr. Seng Ong (orchids), Mr. Seng Poh (acquatic plants), Miss Howes Roberts (seeds from Africa), and Mr. Yee Koon Seng.

Special thanks are due to Captain Johnstone for a large collection of interesting palm seeds, critically selected by himself; and to Mr. J. C. Nauen, who brought from Bermuda a number of seeds of ornamental plants some of which should prove useful additions to our stock of flowering plants.

Seeds and/or plants were received on an exchange basis from botanical gardens or institutes at Berlin, Bonn, Buitenzorg, Calcutta, Canton, Coimbra, Copenhagen, Cuba, Darwin, Dehra Dun (India), Edinburgh, Florida, Glasnevin (Dublin), Honolulu, Kirstenbosch (S. Africa), Kisantu (Belgian Congo), Lyon, Montevideo, Nanking, Oslo, Paris, Pasoeroean (Java), Perth (W. Australia), Rabaul (New Guinea), Saigon, Stockholm, Taihoku (Formosa), Trinidad. A very

valuable exchange of seeds was effected with Messrs. Vilmorin Andrieux & Co. of Paris. Plants or seeds were also exchanged with private individuals in various parts of the world, including South Africa, Australia and Jamaica. A plant of a new almost black-flowered variety of the Common scorpion orchid *(Arachnis flos-aeris* var. *insignis)* from Sumatra, was obtained by exchange with Mr. N. T. NEUBRONNER.

THE BOTANIC GARDENS, SINGAPORE

General routine.—The general maintenance of the Gardens was carried out as usual. An important item of routine which has been introduced in the last few years is the regular digging of trenches around young trees, and replacing the earth with admixture of manure and leaf mould. This has resulted in a much improved growth of young trees, the roots of which often cannot penetrate into the hard clay beyond the limits of the hole which was originally dug for planting. The surplus clay which results from this process is useful for burning for pot plants.

Gingerwort Rockery.—This rockery, lying beside Cluny Road between the plant houses and the propagating yard, had been neglected for some years, owing to pressure of other work and lack of material for new planting. Early in the year, under Mr. CORNER'S supervision, it was cleared of innumerable stray saplings, and partly dug over preparatory to planting with wild plants of the ginger family. Mr. CORNER collected a large number of species of this family from Johore, Pahang and Kemaman, and these were planted in the rockery. About 40 species appear to have established themselves, but they are slow to start, and many losses were suffered through rhizomes being attacked by boring beetles and white ants, and in December the monkeys broke down most of the new growth. The position is a little too open for some of the most shade-loving species, but the majority should grow quite well if they can be protected from the monkeys. A large tuber of *Amorphophallus campanulatus,* received from Mr. G. R. MILLS of Batu Gajah, was planted in the rockery, and has developed a large leaf with stalk about five feet high.

New planting.—A large number of young trees of recent introduction were planted during the year. Mr. CORNER had charge of this work. The various species of Erythrina were mostly planted on lawn F, where, after much digging, they are making good growth. Some of the other trees were planted on the edge of the jungle. If we are to maintain, as we intend, the open vistas in the garden, there is not much room for more tree planting, except by elimination of some common trees which are much duplicated. There is plenty of room for more palms, and a considerable number of seedlings of additional species will soon be ready for planting; only four species were planted in 1935. The newly planted trees, shrubs and climbers are as follows:—

TREES:—*Adinandra sp.* (Cameron's Highlands); *Albizzia ferruginea* (Gold Coast); *A. lebbekoides* (Honolulu); *Ardisia Wallichii* (Cuba); *Artocarpus bracteatus* (Singapore); *A. hypogyrea* (Hong Kong); *Atalantia spinosa* (P. Tioman); *Barringtonia speciosa* (Mersing); *Brachychiton acerifolium, B. discolor & B. rupestris*

(Brisbane) ; *Carya olivaeformis* (Mexico) ; *Cassia grandis* (local), *C. spectabilis* (Buitenzorg) ; *Cleistanthus laevis* (local) ; *Colvillea racemosa* (Calcutta) ; *Connaropsis sp.* (Mawai) ; *Cordia obliqua* (Johore Bahru) ; *Cratoxylon Maingayi* (Penang) ; *Croton pyramidalis* (Br. Honduras) ; *Davidsonia pruriens* (Brisbane) ; *Diospyros sp.* (Johore) ; *Dodonoea viscosa* (Johore) ; *Dysoxylon angustifolium* (Pahang), *D. sp.* (Singapore) ; *Durio sp.* (Johore) ; *Eriobotrya japonica* (B. K. Saheb) ; *Erioglossum edule* (local) ; *Erythrina arborescens* (Nanking), *E. caffra* (Natal), *E. carnea* (Cuba), *E. corallodendron* (Cuba), (Mexico), *E. crista-galli* (Natal), *E. glauca* (Hong Kong) (Trinidad), *E. micropteryx* (Trinidad), *E. monosperma* (Cuba) (Honolulu), *E. pallida* (Trinidad), *E. velutina* (Paris), *E. sp.* (Mexico) ; *Eucalyptus crebra, E. ptychocarpa*, and *E. rostrata* (New Zealand) ; *Eugenia flavifolia* (Br. Honduras), *E. sp.* (Singapore), *E. sp.* (Johore) ; *Ficus calophylla* (Johore), *F. glabella* (local), *F. lepicarpa* (Johore), *F. pisifera* (Johore), *F. Scortechinii* (Johore), *F. sycomorus* (Saigon) ; *Flindersia australis* (Brisbane), *F. brayleana* (Brisbane) ; *Garcinia Gaudichaudii* (Singapore), *G. Maingayi* (Johore) ; *Hopea Mergarawan* (Kepong) ; *Horsfieldia brachiata* (Johore) ; *Khayea senegalensis* (Saigon) ; *Knema sp.* (Singapore) ; *Luchea Seemannii* (Brit Honduras) ; *Mammea americana* (Brit. Honduras) ; *Myristica cinnamomea* (Johore) ; *Parmentiera edulis* (Brit. Honduras) ; *Peltophorum Linnaei* (Trinidad) ; *Pleiogynium Solandri* (Brisbane) ; *Pluméria sericifolia* (Cuba) ; *Querus glauca* (Japan) ; *Randia sp.* (Pahang) ; *Reevesia thyrsoidea* (Hongkong) ; *Sapindus saponarius* (Brit. Honduras) ; *Sapotacea sp.* (Kinabalu B. N. B.) ; *Sapium indicum* (Johore) ; *Schinus terebinthifolius* (Washington) ; *Schizolobium excelsum* (Hawaii) ; *Shorea leprosula* (Kuala Lumpur), *S. microptera* (Kuala Lumpur), *S. pauciflora* (Kuala Lumpur), *S. platyclados* (Kuala Lumpur) ; *Tabebuia guyacum* (Mexico) ; *Terminalia belerica* (Dehra Dun), *T. pyrifolia* (Burma) ; *Wormia albiflos* (Kota Tinggi).

SHRUBS :—*Bauhinia malabarica* (Manila), *B. rosea* (Washington), *B. tomentosa* (Dehra Dun), *B. violacea* (Florida), *B. sp.* (Colombia) ; *Cassia bicapsularis* (Penang), *C. biflora* (Penang) ; *Clerodendron Bakeri* (Kew) ; *Euphorbia abyssinica* (New York), *E. dendroides* (England), *E. neriifolia* (New York), *E. synadenium* (Dindings) ; *Fagraea sp.* (Johore) ; *Gordonia anomala* (Hong Kong) ; *Ixora stenophylla* (Johore) ; *Jatropha hastata* (Cuba) ; *Lafoensia punicifolia* (Raffles College) ; *Schefflera sp.* (Johore) ; *Sophora tetraptera* (N. Zealand) ; *Tecoma sp.* (India).

CLIMBERS :—*Arrabidaea rotundata* (Cuba) ; *Artabotrys uncinatus* (Honolulu) ; *Bauhinia corymbosa* (Honolulu) ; *Bignonia venusta* (Penang) ; *Bougainvillea formosa* (Calcutta), *B. Mrs. Lancaster* (Calcutta), *B. Mrs. Maclean*

(Kew), *B. Scarlet Queen* (Calcutta); *Connarus oligophyllus* (Kemaman); *Maripa nicaraguensis* (Brit. Honduras); *Pandorea australis* (W. Australia); *Rubus rosaefolius* (Perak), *R. sp.* (local); *Stigmaphyllon ledifolium* (Cuba).

CONIFERS:—*Agathis robusta* (Brisbane); *Araucaria brasiliana* (Vilmorin, Paris), *A. Cunninghamii* v. *glauca* (Brisbane); *Callitris glauca* (Brisbane); *Chamaecyparis pisifera squarrosa* (local); *Cupressus arizonica* (Italy), *C. Benthami* (Mexico), *C. macrocarpa* (Italy), *C. sempervirens pyramidalis* (Italy); *Pinus Merkusii* (Penang); *Podocarpus Motleyi* (Kepong); *Thuya gigantea* (Penang).

MISCELLANEOUS:—*Agave applanata* (local), *A. mitis* (Berlin); *Arenga Engleri* (local); *Dracaena granulata* (Johore); *Nenga sp.* (local); *Pandanus helicopus* (Johore), *P. sp.* (Johore); *Yucca aloifolia* (Hamburg), *Y. tricolor* (Hamburg), *Y. tricolor variegata* (Hamburg); *Oreodoxa regia* (local); *Euterpe stenophylla* (local).

The species of Eucalyptus from New Zealand were not strong and some have since died. Of the Bauhinias, *B. violacea* flowered well but the flowers were poor in colour; a few seeds were produced. *Bauhinia malabarica* grew very well but flowered poorly. *Clerodendron Bakeri* (an African species) has made very strong growth but has not flowered. The Euphorbias have made a good start and should make an interesting addition to the Sun Rockery, except *E. dendroides*, which did not survive. For *E. abyssinica* and *E. neriifolia* (of a variety perhaps different from our previous plants of this species) we are indebted to Dr. L. CROIZAT of New York. Plants of the New Zealand *Sophora tetraptera* (Kowhai, sometimes called the national flower of New Zealand) are not strong, and it is doubtful whether they will survive; we have not yet found a woody plant from New Zealand which will flourish in Singapore. *Bignonia venusta*, the beautiful orange-flowered climber which is so fine at Malayan hill-stations, has made strong growth but has shown no signs of flowering; we have no definite record of the behaviour of this species in Singapore, but it probably resembles other fine Bignonias in disliking our climate. *Stigmaphyllon ledifolium* has grown well and flowered; it makes an interesting addition to the group of yellow-flowered climbers of this genus, of which we now have four species. *Araucaria brasiliana* promises to be a noteworthy addition to our conifers; it was raised from seed, apparently for the first time in Singapore. The plants of *Callitris glauca* were lost owing to their being uprooted and thrown into a neighbouring thicket by some malicious person; they had begun to make good growth. The Sumatran Pine *(P. Merkusii)* seedlings, which had been grown for some months in pots on Penang hill, made a little new growth after planting and appear to be in a healthy condition. *Thuja gigantea* has grown very poorly, though it has succeeded well on Penang hill.

NEW HERBACEOUS PLANTS.—A number of trials of herbaceous annuals and perennials were made during the year; of these, the following are worthy of note:—

Anchusa italica, undulata and *sempervirens* (from Lyon). Of these, *A. sempervirens* did not germinate, *A. italica* grew very strongly but did not flower, *A. undulata* flowered and produced good seeds. *A. undulata* is not so showy under our conditions as the Cynoglossums.

Cynoglossum.—We have been growing a Cynoglossum (probably the Indian *C. furcatum)* for some time under the name *Anchusa myosotidiflora*, by which it was received in 1933. Mrs. Bain (Johore Bahru) gave us seeds of another Cynoglossum, which is perhaps another variety of *C. furcatum;* it made a rather better show than the plants we previously possessed. Suttons' Cynoglossum varieties are also being tried, but had not all flowered before the close of the year. These beautiful blue flowers are a notable addition to Malayan gardens.

Asters.—Seeds of several species of perennial Asters were tried, but in no case was there any germination.

Calendula aegyptica grew fairly well and flowered; it is not a first-class annual under local conditions, but is perhaps worth growing for a change.

Coreopsis Atkinsoniana and *C. coronata* both grew well and flowered; they are both quite attractive.

Helianthus argophyllus.—Seeds of this sunflower, which has grey hairy leaves, were received from Saigon. The plants grew well and produced good seeds. Their erect habit and short branches give the plants a pleasing and distinctive appearance, but the flowering period is short. This sunflower is equally suitable for pots or for bedding.

Gazania.—Several plants were raised from seeds brought from Bermuda by Mr. Nauen. They have flowered well for several months, and we hope that they will form a valuable addition to our perennials, which are still very few. It is probable that Gazanias will do best in the sun rockery.

Gerbera avandia grew well, but the flowers are insignificant. Hybrid Gerberas raised from seeds presented by Dr. Moxham in 1933 were planted out in beds and flowered well; they include some pleasing new shades.

Tydea hybrids from Vilmorin grew fairly well and flowered. They are evidently plants that require rather special treatment under Singapore conditions, but it is possible that with care they would be worth growing.

Episcia chontalensis, presented by Rev. Nigel Williams, has made good growth. The pale blue flowers are not so showy as the red flowers of the well-known *E. fulgida,* but the foliage is good.

Cosmos sulphureus.—A packet of seeds of this species was received from Saigon, and the plants proved to be exactly similar to the race we already had in cultivation; but a few plants had deep yellow flowers instead of the usual orange. Seeds of the yellow-flowered plants were kept, and a yellow strain has been isolated which should be a valuable herbaceous plant.

Moraea.—As *M. iridioides* grows well and occasionally flowers pleasantly, other species were introduced for trial during the year; all have grown, but none flowered.

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Artemisia lactiflora, a recent introduction to Singapore, apparently from Java, flowers freely and grows strongly; it is not showy enough to make a really good bedding plant but is an interesting addition to our herbaceous perennials.

Sagittaria.—Two South American species of this group of aquatic plants were raised, *S. montevidensis* and *S. lancifolia;* the former has flowered pleasantly, but is not so strong in growth as the latter, which has not flowered.

Several species of *Meconopsis,* and the New Zealand Forget-me-not *(Myosotidium nobile)* were tried, but failed to germinate.

NOTES ON PLANTS OF INTEREST.—*Jasminum rex. Eranthemum Wattii, Bougainvillea Mrs. McLean* and *Centropogon Lucyanus,* received from Kew towards the end of 1934, all flowered during 1935 and were propagated. The Jasmine has very fine large flowers, but is not very strong in growth. Bougainvillea Mrs. McLEAN has the habit of Mrs. BUTT, and promises to be as free-flowering both as a pot plant and when planted out. So far, it seems to be superior to Louis Wathen, a very similar variety which originated at Madras. *Bougainvillea formosa,* received from Calcutta, grew very rapidly and flowered very freely; this should also be a first-class garden plant and will doubtless be very popular as soon as necessary propagation can be carried out. The larger Bougainvilleas near the Main Gate have now all been attached to tall supports made of 2-inch piping. This allows the long shoots of Mrs. BUTT to rise to a height of about 15 feet and then droop over, showing off the flowers to advantage. It is probable that the additional exposure also helps in the production of flowers.

In view of the success of *Buddleia Davidii* in Singapore, several other species were introduced for trial during the year, but none of them were successful and all plants eventually died. Plants were raised of *B. variabilis* var. *Veitchiana* and var. *magnifica, B. salvifolia* and *B. Hemsleyana.*

Bauhinia Kochiana, introduced many years ago from Sarawak, has long been a very attractive flowering climber on an old Mangosteen tree on lawn E. Efforts to propagate it failed, and no seeds were ever found on the plant. We were fortunate in obtaining a few seeds in 1935, and are able to put other plants on the Bandstand Hill and also in Government House Domain. It is interesting to note that this species has lately been found to be quite abundant in the swampy forest in the Mawai district, being another of the Sarawak plants occurring in Johore. *Bauhinia bidentata,* which was planted on some other trees on lawn E a few years ago, flowered for the first time in 1935. For further remarks about this species, see under the heading Waterfall Garden, Penang.

Pereskia grandifolia, lost to the Gardens for some years, was planted on the Bandstand Hill, and flowered continuously. A pink-flowered seedling *Lantana* growing in a palm clump was noticed to be very floriferous, and propagated by cuttings. When put out in a separate bed, the plants grew strongly and flowered very freely and continuously forming one of the showiest shrubs in the Gardens. The white-flowered variety introduced recently from Penang also flowered freely. An orange-red variety was presented by Mr. J. A. LE DOUX, and it is hoped that other useful types may be raised from seeds obtained from Messrs Vilmorin Andrieux & Co.

The group of conifers planted in 1932 in lawn D, between the herbarium and the lake, have made excellent growth. At the end of 1935, the *Cupressus funebris* and the tallest of the *C. macrocarpa* seedlings raised from Peradeniya seed, were about 15 feet tall, and the group contained plants of 14 species of the genera Pinus, Podocarpus, Cupressus and Juniperus. Several more species are being raised in the potting yard, including Thuja *orientalis* var. *compacta* and var. *elegantissima,* and *Juniperus bermudianus.*

Among the other ornamental plants raised from seeds during the year were *Jatropha hastata* (from Cuba), *Beloperone guttata* and *Alstonia venenata* (flowering shrubs, from Bermuda), *Schotia latifolia, Petrea arborea, Brunfelsia Sieberi, Thunbergia coccinea* and *Cycas neo-caledoniae.* Dr. HERKLOTS, of the University of Hong Kong, sent on exchange some plants of Azaleas, *Gordonia anomala, Malvaviscus grandifolius,* and a double Poinsettia, all of which we hope will be useful introductions. The Secretary of the Agri-Horticultural Society of India kindly sent cuttings of three varieties of Poinsettia, which have grown but do not seem to be very vigorous; an almost white variety has flowered poorly.

Losses.—An old Mahogany tree near the Director's house was blown down; old trees of Tamarind, Sentol (Sandoricum) and Tampang *(Artocarpus Gomeziana)* were removed in a dying condition. The *Corypha gebanga* near the office, its fruits being ripe, was cut down, as it was unsafe. The trunk was 70 feet tall, and fully four feet in diameter at the base. A shrub of *Nicodemia diversifolia,* received some years ago from Bombay, was removed as it is of no particular ornamental value. A few plants were lost by theft from beds round the Bandstand Hill, including *Crinum giganteum,* Gerberas, Dianthus and Crossandras. A few other plants, chiefly young trees, were pulled up and thrown away into nearby thickets, apparently from purely mischievous motives; the offenders were not caught. Monkeys continue to cause much damage to young plants, especially in the Garden Jungle, where herbaceous plants are almost all destroyed.

Orchids.—The principal addition to the orchid collection during the year was a consignment of plants, chiefly Dendrobiums, from New Guinea, sent by Mr. C. E. CARR. Some other New Guinea orchids were received on exchange from the Department of Agriculture, Rabaul. Some hybrids, including *Vanda Delia Dakkus,* were presented by Mr. P. M. W. DAKKUS, Curator of the Botanic Gardens, Buitenzorg. A few plants of Broughtonia were received as exchange from Mr. CRADWICK of Jamaica. Mr. H. L. JEPPESEN presented plants of two varieties of *Arachnis Maingayi,* and the new *A. flos-aeris* var. *insignis* was acquired by exchange from Mr. NEUBRONNER.

Brassocattleya Gatton Lily, received from Sir JEREMIAH COLMAN, flowered for the first time about two years after it arrived in Singapore; it flowered again shortly afterwards, and appears likely to flower regularly in future. The plant is growing strongly, and is a very fine addition to our orchid collection. Two hybrid Dendrobiums, also presented by Sir JEREMIAH, flowered during the year, but not very freely; they are Royal Sovereign and Prince Arthur. The

Pahang *Dendrobium Farmeri* flowered well as usual, one plant bearing simultaneously 14 inflorescences. A plant of *Coelogyne Kingii* flowered particularly well, and it is evident that this species, with its tall erect inflorescence and pure white flowers, is a very fine one; unfortunately it is not very floriferous in Singapore. A plant of *Dendrobium bracteosum* from New Guinea flowered most attractively. A plant of *Catasetum macrocarpum* has flowered several times, and an account of the genus was written by the Director for the *Malayan Orchid Review.*

Mr. NAUEN took over charge of the hybrid seedlings after his arrival, and effected some improvements in treatment, as a result of which we hope that the young plants will progress more rapidly. Undoubtedly their progress to date, except for Spathoglottis and some of the Vanda-Arachnis hybrids, has left much to be desired. A progress report on the hybrids was published by the Director on the *Malayan Orchid Review,* and also a description of the Phalaenopsis hybrid which flowered towards the end of 1934; this hybrid *(P. violacea × amabilis)* was called "Anak Bulan", as the white-flowered parent is called the moon or *bulan* orchid in Java. The most interesting event during the year was the flowering of plants of the cross *Spathoglottis Vieillardii × S. affinis.* These have the habit of *S. affinis,* but the vigour of the other parent; the flowers range in colour from a rich orange to a very pale tint, the yellow and purple colour factors varying independently to give a very great variety of combinations. The finest are very richly coloured. Attempts are being made to cross these with the *S. aurea* hybrids, but very few seeds result. A successful cross has been made with *S. zebrina* (presented by Sir JEREMIAH COLMAN), which has yellow flowers. Seedlings are also being raised of a cross between *S. aurea* and the fine Penang White variety of *S. plicata,* presented in 1934 by Mr. YEOH BOK CHOON. Other Spathoglottis plants received during the year were *S. chrysantha* (by exchange with the Gem Nursery) ; also *S. plicata* var *moluccana* and *S. Vanvuurenii* from Buitenzorg, the former a very fine variety, the latter an interesting pale mauve species from Celebes. The Arachnis-Renanthera and Arachnis-Vanda hybrids made good growth, and *A. flos-aeris × Hookeriana* had begun to produce its first inflorescence at the end of the year.

Buildings, Masonry, etc.—The Carpenter's quarters were rebuilt by the Public Works Department and the two glass-roofed propagating houses in the potting yard were repaired extensively by the Gardens carpenter. The woodwork and wire netting of the palm seedling house were renewed. A new pergola, built of used Chinese bricks and old timber, was made along the southern path connecting the Upper and Lower Ring roads, and the steps at either end were remade and graded less steeply. This pergola should greatly improve the appearance of the terraces on the southern slopes of the Bandstand Hill, and will provide a convenient support for some big climbers. An ironwork arch had to be removed to another place on the circular path. The carpenter made a mould for the construction of large square concrete pots, to replace wooden tubs for palms and other large plants. It is hoped gradually to replace all the wooden tubs. Some wooden propagating benches were also replaced by concrete. A new concrete propagating frame, with a water tank below and a layer of coir dust, was made in the potting yard for experimental purposes.

The Tea Kiosk was taken over by a new lessee, who gave improved service. The building was repaired and a small extension made by the Public Works Department. The Children's sand-pit was re-filled with sand.

THE WATERFALL GARDENS, PENANG

The general maintenance of the garden was carried on as usual, and an excellent standard was maintained. The path across section H was closed, to allow for a programme of planting the various species of bamboos in this area. An unsightly mixed group of Rambutan, rattans and other palms situated near the middle bridge was cleared away, with the exception of one Nibong palm, and the area levelled and turfed. The sharp slope behind was planted up in mass formation with Poinsettias. At the same time various redundant palms were removed from the top of the slope.

New planting.—In section E the following Bougainvilleas were added to the group: 20 seedlings of *B. lateritia* (in four beds), three plants of Louis Wathen, one seedling from Maud Chettleburgh, three Crimson Lake, one *B. Thomasii,* one Mrs. McLEAN. The seedling of Maud Chettleburg produced a few pink flowers and is quite different from its parent. Seedlings have also been raised from *B. formosa,* Rosa Catalina and *glabra,* but these have not yet flowered and are not yet planted out in the Garden. At the western end of section E, plants of all the available species of *Saraca* were set out in a group, and also two plants of *S. taipingensis* in the neighbouring rockery. Oleander plants were grouped together on the bank of the stream at the eastern end of section E; five varieties were included. In section H two new plants of *Adansonia digitata* (the African Baobab) made good new growth; it is evident that the site selected at the top of section E for the former plant of this species was not suitable. A considerable number of *Ixora* and *Brunfelsia* plants were also planted at the upper end of section H, and near the stream the following bamboos: *Gigantochloa ligulata, G. Kurzii, Schizostachyum brachycladum, S. longispiculatum, Thyrsostachys siamensis, Oxytenanthera nigro-ciliata.* In the adjoining portion of section J other bamboos were planted as follows: *Bambusa vulgaris* var. *striata, B. teres, B. nana, B. vulgaris, B. gigantea.* The naming of some of these bamboos is tentative. Species added to the Ficus group in section L was *F. religiosa, F. elastica* var. *variegata, F. viridicarpa* and an unnamed species. In Section O nine seedling Plumerias obtained from a fine hybrid in the collection were planted. The total number of new woody plants put out in the garden during the year was 262.

Masonry, etc.—New raised water tanks were constructed in plant houses 4, 5, 7 and 9, to replace sunken tanks, as an anti-malarial measure. New drains were made, and old drains altered or reconstructed at the lower end of section F, above section G at the foot of the jungle, along the lower portion of the Upper North Road, in the potting yard (in connection with rebuilding plant house No. 7), and minor changes elsewhere; roadside curbs were made in connection with drains on the Upper Circular and Upper North roads, to protect the side-tables. Permanent concrete steps were made in the potting yard to accomodate the Dendrobiums. Crazy paving was laid around the semicircular seat in the formal garden, section V.

Buildings.—Plant-house No. 7 (in the potting yard) was completely rebuilt with concrete posts, steel roof framework and hardwood laths, by the Public Works Department. An expanded metal lock-up store was constructed in the potting shed. Plant houses 4 and 5 were re-roofed with attaps by the Gardens staff.

Notes on plants of interest.—*Bauhinia bidentata* gave a very fine display of bloom on the roof of plant house No. 3 in February. It was planted there about 10 years ago and first flowered in 1931. It is the commonest large climbing Bauhinia in the Peninsula and often covers the crowns of large forest trees with a mass of orange flowers. It is worth planting in any large garden, its only disadvantages being the large size of the plants and the fact that they usually only flower once a year. *Lagerstroemia Loudonii* flowered in March, and is a very attractive addition to the flowering trees in the Garden. It was introduced a few years ago by seeds from Siam. As mentioned above under *new planting,* seeds were obtained from five different Bougainvilleas, and seedlings raised. The only Bougainvillea from which seeds have formerly been obtained at Penang was *B. lateritia.* It is hoped that some of the seedlings may produce new varieties. The upper slopes of lawn E have proved very suitable for this group of plants and the collection is being gradually enlarged. The very fine African climber *Camoensia maxima* produced a fruit for the first time on record at Penang; the pod contained two seeds. The large clump of Bamboo near the stream in section S flowered for the first time on record; the flowers have enabled it to be identified as *Bambusa teres,* a species from Assam.

Section V.—The formal garden in this section has been made very attractive, and arrangements for opening it to the public were made at the end of the year. Mr. FLIPPANCE drew up plans for developing the remainder of the section with herbaceous borders, lotus tank, pillars for climbers, and at the far end a raised terrace to accomodate a small pavilion and pergolas, with a paved area in front of the terrace. It is intended to carry out these plans as far as possible in 1936, and a special vote of $2,000 has been provided for the purpose.

GOVERNMENT HOUSE DOMAIN AND OTHER OUTSIDE CHARGES

SINGAPORE

Government House Domain.—Mr. BEST had charge of work in the Domain until September, when he handed over to Mr. NAUEN. The general maintenance of the outer parts of the Domain continued as usual, the chief change being the use of an "Autoscythe" instead of bent-cutters to cut the rougher areas of grass, where ordinary mowers cannot be used. Several dead or unsightly trees were removed from various places, and several strangling figs were cut away from Eugenia and other trees. New trees were planted along the drive to the stables (Cassias and Jacaranda), and in the neighbourhood of the lower tennis courts, where a number of additional flowering and other trees were needed to accompany the new planting scheme on the terrace.

The flower beds on the terraces in front of Government house were re-arranged, and herbaceous borders were made on either side of the central path on the uppermost terrace. The Canna beds were made to form a continuous sweep from the end of the first tennis court to the large Lagerstroemia opposite the Guard Room, and beyond the line of Canna beds, at the end of the far terrace, young trees of Jacaranda and pink Cassia were planted in a semicircle, with two Bougainvillea Mrs. BUTT to add a touch of brighter colour. The herbaceous borders were filled with a succession of varied small flowering plants and looked bright at almost all times of the year. Oleanders were planted in front of the pillars of the porch of Government House, and a selection of standard Hibiscus on the small terrace near His Excellency's office. The shrubs planted in the area to the left of the drive beyond the southern end of the House were all removed except the broad border of Congea, and to this were added Petrea, Kopsia and white Bauhinia.

A formal water-garden was made on the site of the lower tennis courts, an area about 75 by 55 yards. The area was divided into four equal parts by crazy-paved paths converging from the boundaries upon a rectangular pool in the centre, the main path beginning at the base of the existing steps, flanking the pool on either side, and continuing to the far boundary, where a small shelter was built. The pool, which measures 60 by 15 feet, and the crazy paving, were constructed by the Public Works Department. The lay-out of the area was completed with beds of small flowering shrubs in a formal scheme, with a row of *Juniperus chinensis* on either side of the main path.

During the latter part of the year the reconstruction of the enclosed nursery was begun, to allow more room for orchids, annuals and other flowers for cutting; *Gladiolus* and *Asparagus plumosus* were added. The site of the vegetable beds was changed. New supports for climbers which provide cut flowers were put up in the area formerly occupied by coolies' quarters. The pot plant stands were somewhat extended. The foliage pot plants were thoroughly overhauled and most were re-potted. A number of plants of Congea and Caesalpinia were planted in the areas near the nursery, to provide an additional supply of cut flowers.

At the Colonial Secretary's House, a new vegetable garden was made, the area formerly used for this purpose being made into a small enclosed garden with a herbaceous border. The beds on the terrace garden were made more symmetrical.

Municipal.—Weekly inspections of roadside trees were made for the Municipal Commissioners, and reports on necessary planting, pruning, spraying and removal of unsightly or dead trees were made regularly to the Municipal Engineer. New planting was carried out in Tanglin Road, Bukit Timah Road, Clemenceau Avenue, Changi Road, Braddell Road, Farrer Road, Al-Junied Road and Tiong Bahru Road, and in addition replacements were made in other roads. *Adinobotrys atropurpurea* and *Cassia nodosa* have been added to the stock of tree seedlings at the Woodleigh Nursery, and *Cassia siamea* has been discarded. Advice on planting was given in connection with the development of a park and playing fields on the site of the old race course, and a considerable number of ornamental trees were planted. Plans were also drawn up for re-arrangement of beds at Katong Park and in front of the Municipal Offices.

Advice was given on the planting of trees and other ornamental plants at the R.A.F. Station, the Singapore Golf Club, the Raffles Museum and at various schools.

Planting in Water Catchment Area.—Mr. CORNER continued in charge of this work. Very few of the flowering trees which were planted in 1931 on the north side of MacRitchie Reservoir have succeeded. They appear to be unable to thrive in the poor heavy soil round the edge of the water, or in some cases to compete with the forest trees. The Spathodea trees began well, but after two years started to die back. Poinciana could not stand the partial shade. Peltophorum appeared to be hampered by hard soil. The foliage of Lagerstroemia was continually eaten by beetles. The Jacaranda trees alone have grown strongly, and may perhaps achieve the object of providing flowers on the edge of the forest. Of the trees planted along the foot of the golf course, Parkia has suffered incessantly from insect pests, and a substitute will have to be found. The young trees of Adinobotrys have at length established themselves. This species promises to be the best large tree for such hard exposed soil. Most of the Alstonia and Dillenia trees planted by the path leading from the head of the Reservoir to the Meter-house are fully established, and also the Parkia, Saraca and *Cassia multijuga* planted round the Meter-house. The Saraca has grown remarkably well at the edge of the *bĕlukar* (scrub) and as this is one of the most handsome small flowering trees, and is indigenous to Malayan forests, it is intended to plant as many as possible. In April and December about 100 seedlings of *Saraca taipingensis, S. declinata* and *S. triandra* were planted along the upper path from the golf course to the Meter-house. If they grow well, these should give massed flowering from time to time beside the path. The planting of fine ornamental trees in areas impoverished *bĕlukar* such as much of the Catchment Area is a more difficult problem than was at first supposed. Suitable trees can be found, but it will be a matter of trial and error.

The trees planted on the hillsides at the 8½ mile Thomson Road have also behaved unevenly; some have succeeded, but about half have died back. If a special labour force were available to attend to them, most of them could be made to grow vigorously; but in the absence of such we must be content to observe which kinds can maintain themselves in the first few years of growth, and continue to plant those. Planting of such trees is well worth while; under their shade the soil conditions will improve. In April a further consignment of about 150 seedlings of Albizzia, Hymenaea, *Cratoxylon Maingayi*, and Adinobotrys were sent to the 8½ mile Thomson Road, and in December about 100 seedlings of *Artocarpus Kunstleri, A. bracteata, A. lakoocha* and *A. rigida* were sent. Seeds of some of these trees were also sent to be sown at a small nursery at the 8½ mile, where they are in charge of the mandor at the Cooly Lines.

Unfortunately Chinese squatters from the 6th mile Bukit Timah Road and the 5th mile Thomson Road continue to cut down and devastate the better parts of the *bĕlukar*, and what remains of forest, between the Pierce and MacRitchie reservoirs. In so doing, they set back the natural regeneration of the forest by twenty or thirty years, and let in thickets of rĕsam and bracken in which re-establishment of the forest is almost impossible. The destruction they are causing cannot possibly be made good by any planting scheme which it would be practicable to carry out.

PENANG

Hill Gardens.—The gardens at Bel Retiro, Strawberry Hill, The Crag Hotel, Bellevue, Convalescent, Fern Hill, Woodside and Hillside were maintained during the year as usual. At Bel Retiro the principal changes were on the west and south sides of the house, the western slope being improved and the old Hibiscus hedge removed, and a low Bougainvillea hedge planted on the west side of the southern end of the house. At the Crag Hotel the new terraces at the entrance were planted, thus greatly improving the approach to the hotel, and a path was made connecting these terraces with the grotto path below the dining room block; this provides an almost level path from the entrance to the Barracks on the north side of the hotel. The area below the north Barracks was cleared, levelled and planted with roses. Six *Cassia fistula* and six *Peltophorum* trees were planted to provide a little yellow colour among the massed Bougainvilleas below the dining room. The slopes between Fern Hill and Convalescent which had been cleared and prepared in 1934, were planted with conifers; on the west slope 70 plants of *Pinus Merkusii* and on the east slope a mixture of *Araucaria Cunninghamii, Thuja plicata, Cryptomeria japonica* and *Pinus Merkusii.* This is the first attempt at a conifer plantation on Penang hill, and its progress will be of considerable interest.

Various new plants were tried in the Bel Retiro nursery during the year. The following bulbous plants were grown and flowered successfully: *Narcissus polyanthus* varieties, Watsonia, Montbretia, Gladiolus, Colchicum, and tuberous rooted Begonias. The Colchicum bulbs flowered in one week after planting. The following gave poor results and are evidently not suited to cultivation on Penang Hill: Daffodil, Iris, (tuberous rooted), Crocus, Chionodoxa, Hyacinth, Tulip, Cyclamen. A new consignment of roses was imported from England and successfully established, but it is still too early to report on them. Many seeds were also tried, but no new plants of particular merit were produced. A small additional nursery, to be devoted entirely to trials of new plants, is desirable.

The Residency.—As in former years, advice on garden work at the Residency was given by Mr. FLIPPANCE, and arrangements were made for taking full charge in 1936. During 1935, considerable changes were made in the Residency garden; Mr. FLIPPANCE made preliminary plans for these, and supervised the new lay-out. A new terrace garden was made on the west side of the house, the long herbaceous border was altered and considerably extended, the Canna beds set back to correspond, and provision made for a pergola behind them. The orchid garden was re-planned and re-planted. A number of trees were planted in the outlying parts of the grounds.

General Hospital.—A plan was prepared for the lay-out of the area in front of the new staff quarters. Work began in September, the Gardens Department cutting the path and planting borders of shrubs and flower-beds, and the Public Works Department dealing with the grass areas. It is hoped to complete the work in 1936.

Municipal.—The usual inspections of roadside trees were made and reports submitted to the Municipal Engineer.

Other Work.—Advice was given to various institutions and private residents concerning planting schemes, grass maintenance, tree planting and pruning, etc.; these included the Penang Flying Club, the Penang Golf Club, the Penang Swimming Club, the Penang Turf Club, and the Penang Club. A plan was also made for laying out a proposed public garden at Fort Cornwallis.

R. E. HOLTTUM,
Director of Gardens,
Straits Settlements.

STRAITS SETTLEMENTS

Annual Report of the Director of Gardens for the year 1936

BY

R. E. HOLTTUM, M.A., F.L.S.,
Director of Gardens, S.S.

Published by Authority

SINGAPORE:
Printed at the Government Printing Office, Singapore,
by V. C. G. Gatrell, Acting Government Printer.

1937

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ANNUAL REPORT OF THE DIRECTOR OF GARDENS, STRAITS SETTLEMENTS, FOR THE YEAR 1936

By R. E. HOLTTUM, M.A., F.L.S., *Director of Gardens, S.S.*

STAFF

Mr. M. R. HENDERSON, Curator of the Herbarium, was absent on leave from February 19th to December 18th; during this absence he spent one month on duty at Kew, consulting specimens and literature not available in Singapore. It is reported with regret that Mr. G. A. BEST, Assistant Curator, Gardens, Singapore, was certified on medical grounds to be unfit for further service from November 28th. He has served since 1921. The remaining members of the staff were on duty throughout the year.

Mr. C. X. FURTADO, Assistant Botanist, spent most of April on duty at Buitenzorg, for the purpose of studying palms (as reported below). He visited the Botanic Gardens, the Herbarium and the Forestry Institute, to the officials of which grateful thanks are offered for facilities provided to Mr. FURTADO in his work.

LABOUR

The labour force both at Singapore and Penang remained approximately the same as in 1935, and rates of pay were unchanged. Health was again satisfactory, and it is gratifying to report that for the first time no cases of malaria were recorded among the staff at Penang, including the watchmen who are on duty at night. This state of affairs indicates the efficiency of the anti-malarial work carried out by the Health Department.

At Singapore the Tamils employed at the Gardens and in Government House Domain took part in the general strike of Tamil labourers from December 2nd to 14th. Some Malays and Javanese were taken on temporarily to carry on necessary duties, and a few of these were retained permanently, the Tamil staff being correspondingly reduced.

REVENUE

The revenue from the sale of plants, etc. was as follows:—

	$ c.
Singapore:—	
Sale of plants and seeds	1,678 83
Inspection fees, etc.	349 45
Penang:—	
Sale of plants and seeds	566 16
Sale of guides	6 00

At both Singapore and Penang the Municipal Commissioners paid the sum of $100 p.m. for advice regarding the planting and maintenance of Roadside Trees.

PLANT COLLECTIONS AND FIELD EXCURSIONS

Mr. CORNER made two tours for the purpose of studying the common trees in the country, in preparation for his book on the subject, with the object of making the book fully representative of all parts of Malaya. At the end of February he spent a fortnight travelling through Malacca, Negri Sembilan, Pahang and Selangor, to photograph specimen trees and to discover their local names. In July he spent a month in Kedah, Perlis, Penang and Upper Perak, which have many trees not found in the south; he visited especially the neighbourhood of Alor Star, Arau, Baling, Penang Hill, Grik, Kuala Kangsar and Pangkor, studying trees at the rate of twelve different kinds a day for the whole month. He paid particular attention to local names in Kedah and Upper Perak. Many interesting discoveries, such as the following, resulted from this tour. The fruits of a rare Elaeocarpus were being sold in the market at Baling; several kinds of trees, supposed to occur only on the east coast of Malaya, were found to abound in the forest-coves of Pangkor; several species of Ficus new to the Peninsula flora were found to flourish on the Padang at Grik; the Tembusu was found to be almost unknown in Perak; a tree described by Jack more than a century ago and subsequently not collected nor recognised by local botanists was found to be a well-known village tree with the name of Sentang. The wealth of trees in this country is in fact so great that even the common ones are still imperfectly known. It is much to be hoped that Mr. CORNER'S book when completed will form a basis on which not only the specialist but all who take an interest in plants may build. Mr. CORNER took about 60 photographs of trees on these expeditions.

Mr. CORNER also undertook a short expedition in April to the neighbourhood of Mawai, continuing his study of the freshwater swamp forest. He also made numerous one-day excursions to the same district. In October the two Plant Collectors, Kiah and Ngadiman, spent the month collecting near the new Mersing Road, where trees were being felled. This district of Johore continues to produce many plants of great interest, successive collections serving to reveal still further the richness of the flora.

In addition to herbarium specimens from this area, Mr. CORNER brought a considerable number of interesting epiphytes and other plants for cultivation and study in the Botanic Gardens. Thanks are due to the Conservator of Forests, Johore for the assistance of a Forest Guard in the work of plant collecting, and to Mr. H. G. GRIEVE, of Tebrau, for hospitality.

The Director visited Cameron Highlands in May, collecting chiefly in the areas opened up by the new road into the Telom valley. A considerable number of trees were found in flower and fruit. Three species of ferns were found for the first time in the Peninsula, field studies were made of three other species subsequently described as new, and a number of other ferns and herbaceous plants were added to the list of the Highlands flora. The most interesting of the herbaceous plants was *Anemone sumatrana,* hitherto only known in the Peninsula from Gunong Benom, where it was once collected at about 6,000 feet. It proves to be abundant beside the rivers in the Telom valley at about 4,000 feet above sea level. A number of ferns and other plants were brought to Singapore for cultivation, and some sent to Penang also.

CLASSES FOR SCHOOL TEACHERS

At the request of the Inspector of Schools, Singapore and Labuan, Mr. CORNER again held a series of classes on Malayan Plant Life for teachers in local schools. The classes were held on Friday afternoons at the Singapore Chinese Girls School and were attended by 35 teachers. The series consisted of twenty periods of 1½ hours each. As last year, the course was designed to give an introduction to the study of local flowering plants with the minimum of technicality.

A second course, in Systematic Botany, was held at the Botanic Gardens on Saturday mornings. This was attended by the twelve most successful teachers of the preceding year's elementary course. Fifteen classes were held, each of 1½ to 2½ hours, and six excursions to different parts of the island : the Reservoir jungle, Bukit Timah, the coast at Labrador, the West Coast Road and Mandai Road. The classes at the Botanic Gardens were devoted entirely to the dissection and drawing of the flowers and fruits of as many common plants, in as many families, as time permitted, care being given to include those most suited for teaching botany in schools. These classes, it is hoped, have made a real start in the teaching of botany in Malaya. Mr. CORNER's book, which as mentioned elsewhere in this Report is in active preparation, should greatly assist the development of this teaching.

HERBARIUM WORK AND OTHER INVESTIGATIONS

Mr. HENDERSON, Curator of the Herbarium, was absent on leave during the greater part of the year. While on leave, he spent a month on duty at Kew, chiefly devoted to a continuation of his study of the genus Eugenia. Eugenia is a large genus, some 140 species being recorded in the Peninsula, many of them common trees (known locally as Jambu, Krian, Kĕlat, etc.). The distinctions between the species (which are often closely allied) have in many cases not been adequately recorded, with the result that there has been much confusion and doubt about the correct names of many local species. Another cause of confusion has been the fact that some species of wide geographical range have received different names in different countries. In order to clear up the confusion it is necessary first to study, the type specimens upon which our local species are based, and also to study authentic specimens of species from neighbouring countries, India, Burma, Siam, Indo-China, and the Malaysian region generally. Many type specimens (chiefly from the collections of WALLICH and GRIFITH) are in the Kew herbarium; considerable collections from the neighbouring countries are also available. Mr. HENDERSON was able to check the names of many of the local species, and to establish the identity of some of them with species described from neighbouring countries. For example, a common Singapore species which could not be certainly named from published descriptions was found to be *Eugenia fusiformis,* described by DUTHIE from a Malacca specimen in 1878; it was also found that the same species had been re-named later in the Philippines. The genus Eugenia is particularly difficult, not only from the great profusion of species, but because some of them seem to be very variable while others are not, so that the study of considerable numbers of specimens is necessary. Thanks are due to the Director of the Royal Botanic Gardens, Kew, and to the staff of the Herbarium for facilities granted to Mr. HENDERSON, and for assistance during the course of his work.

Mr. CORNER spent the greater part of the year working in the general herbarium, preparing for the publication of a book on the common trees of

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the Peninsula. Unfortunately there is still much confusion in the naming of a great many of these trees, and the published descriptions are not only inadequate, but being based on dried specimens are often misleading to anyone studying living trees. It is most desirable to have the names published in the new book as accurate as possible, as it is hoped the book will be a standard one for some time to come. Mr. CORNER has therefore been obliged to study critically the nomenclature in every genus he has encountered, and he has also drawn up original descriptions, based as far as possible on fresh specimens collected by himself. This has involved enormous labour, and in twelve months of almost continuous work, often up to 10 hours a day, he has not covered all the necessary ground preliminary to the actual writing of the book. The necessity for consulting work on the plants of neighbouring countries, mentioned above in connection with Eugenia, applies to a still greater extent with the common trees dealt with by Mr. CORNER. The names of many such trees, as recorded in Ridley's *Flora*, have been altered by botanists working chiefly at Manila and Buitenzorg, and it has been necessary to check their work, which in many cases has been found doubtful or inaccurate. Mr. CORNER has in fact been obliged to undertake fundamental taxonomical research in nearly every group of trees he has dealt with. He found for example that the confusion in the genus Artocarpus is such that the correct botanical names for the Jack-fruit, the Bread-fruit and the Chempĕdak are still unknown, that the well-known Malayan fruit Tampoi is unrecorded or misidentified in works on Malayan botany, and that the names of the common species of Wormia, Eugenia and Ixora have nearly all to be changed.

Mr. FURTADO carried on routine work in the Herbarium in the absence of Mr. HENDERSON. He devoted the greater part of his time to a continuation of his study of rattans, and to studying the application of the rules of botanical nomenclature, which leads to some rather complex problems in connection with the naming of local plants. In this matter he was of considerable assistance to Mr. CORNER in the work described above.

Mr. FURTADO'S visit to Buitenzorg in April enabled him to add considerably to his knowledge of rattans and other palms, and also to collect valuable material for the Singapore herbarium. At Buitenzorg is a very large collection of living rattan plants, collected from various parts of tropical Asia. BECCARI based many of his species on them and on other palms cultivated at Buitenzorg, so that they are of great botanical importance. Mr. FURTADO, with the assistance of the Buitenzorg staff, was able to collect specimens from 190 individual plants (about 1,000 specimens altogether). These specimens were brought to Singapore, and duplicates were distributed from here after a preliminary study in the herbarium. The result was the addition to our herbarium of more than 100 species not previously represented, and the collection constitutes the most valuable contribution ever made to our palm collection. Mr. FURTADO'S studies of rattan plants in cultivation both in Singapore and at Buitenzorg enabled him to confirm BECCARI'S assertion (which other botanists have denied) that the rattan genera Calamus and Daemonorops are normally dioecious (*i.e.*, male and female flowers are borne on separate plants). He has embodied his observations on this matter in a paper which will be published in the Gardens Bulletin.

Mr. FURTADO'S studies in the application of the Rules of botanical nomenclature led him to the conclusion that some confusion is caused by the inadequate interpretation of the terms *valid* and *legitimate;* and also to make various other proposals for the more precise definition of the Rules;

he further proposed a terminology to indicate the exact nature of the various kinds of type specimens and their taxonomical status. These observations and proposals have been embodied in two papers which it is proposed to publish in the Gardens Bulletin.

The Director completed his study of the genus Lomagramma, a group of climbing ferns found in forests from Assam and southern China through the Malaysian region to the Pacific. Two species occur in the Malay Peninsula, and their status could not be determined without a consideration of the other species. The result fills a gap in the taxonomy of ferns and throws an interesting light on the biology of climbing ferns. Mr. Holttum also studied recent fern collections, including those made by himself at Cameron Highlands, and prepared a paper containing critical notes on local species, additions to the known fern flora of the Peninsula, and the description of five new species. The results of this work will be published in the Bulletin.

The Director continued his study of orchid seedlings, and a number of new hybrids were raised. An account of the horticultural aspect of this work appears in a later section of this report. Three new hybrids flowered during the year, and two were illustrated and described in the Malayan Orchid Review. One of these is, so far as our information goes, the first reported Arachnis-Renanthera hybrids to flower, and shows characters closely intermedite between its two parents, *Arachnis Hookeriana* and *Renanthera coccinea*. *Arachnis Hookeriana* × *flos-aeris* proved to be hardly distinguishable from *A. Maingayi*, a species described from Malacca and found also in Borneo and Sumatra. It is thus probable that *A. Maingayi*, which has several varieties, is of hybrid origin. A few second generation Spathoglottis hybrids have been raised, but the first hybrids in this genus are almost sterile. One second generation hybrid, *S. Parsonsii* (=*S. plicata* × *S. vanoverberghii*) crossed with a large white variety of *S. plicata*, has flowered, and will be described in 1937. There is some variation in colouring among the progeny, but no noticeable variation in shape or form.

Owing to Mr. Henderson's absence, the number of duplicate herbarium specimens distributed was less than in recent years, being as follows:—

Botanic Gardens, Buitenzorg	541
Prof. Woon Young Chun, Canton	188
Prof. H. H. Bartlett, Univ. of Michigan ...	179
Botanic Gardens, Berlin	144
Arnold Arboretum, U. S. A.	133
Royal Botanic Gardens, Calcutta	133
Fan Memorial Institute, Peiping (ferns) ...	89
Bureau of Science, Manila	88
Total ...	1,806

Specimens were sent on loan for study by botanists at other institutions as follows:—

Prof. Woon Young Chun, Canton (Gesneraceæ)	281
Prof. Y. Tsiang, Canton (Apocynaceæ) ...	110
Forest Research Inst. Kepong (Baccaurea, Wormia)	24
Dr. F. P. Metcalf, Lingnan University, Canton (Zizyphus, Dracontomelum)	12
Carried forward ...	427

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Brought forward ...	427
Dr. H. R. Fletcher, Royal Botanic Gardens, Edinburgh, (Diospyros)	11
Prof. H. J. Lam, Leiden, (Macaranga) ...	10
Dr. W. E. Manning, Smith College, U. S. A. (Englehardtia)	9
Dr. A. F. G. Kerr, Kew, (Holarrhena) ...	7
Dr. van Steenis, Buitenzorg, (Baccaurea) ...	2
Total ...	466

Specimens were received in exchange as follows :—

Botanic Gardens, Buitenzorg	861
Prof. H. H. Bartlett, University of Michigan (Sumatran plants)	474
Bureau of Science, Manila, (Philippine plants) ...	270
Botanic Gardens, Berlin (Palms)	25
Royal Botanic Gardens, Kew (Palms) ...	5
Total ...	1,635

The number of specimens mounted and laid into the herbarium during the year was as follows :—

Local collections and Gardens Herbarium ...	1,526 sheets
Specimens received in exchange and by purchase ...	2,563 sheets
Total ...	4,089

As in the previous year, assistance was given to Mr. C. E. Carr by sorting and distributing his botanical collections made in New Guinea. This service was given in part payment for a set of Mr. Carr's specimens which form a valuable addition to the herbarium. The exact total is not yet known, but it is probable that it will amount to nearly 7,000 numbers. Mr. Carr's death at Port Moresby on 3rd June, 1936 brought to an untimely end what promised to be a brilliant career, and deprived Malayan botany of a student of orchids whom it will be difficult to replace. Mr. Carr left at Singapore many unnamed collections from Borneo and elsewhere which he hoped to described after his return from New Guinea. These specimens, with the remainder of Mr. Carr's private orchid herbarium, consisting altogether of some 900 named and mounted specimens, a nearly equal number of named specimens preserved in alcohol, and about 2,500 unnamed specimens, had been left in the Director's charge during Mr. Carr's New Guinea expedition. After his death, the trustee of his estate allowed the Botanic Gardens the first offer of purchase; a proposal to this effect was approved by the Government. This has resulted in the addition to our herbarium of all Mr. Carr's locally collected specimens, with his critical notes attached, which add so much to our knowledge of the local orchid flora.

The following visiting botanists worked in the herbarium : Professor T. Tanaka (Taihoku) on Citrus and allied genera, Mr. J. N. Milsum (Department of Agriculture) on Citrus, and Mr. C. F. Symington on various forest trees.

PUBLICATIONS

No issue of the Gardens Bulletin Straits Settlements was published during the year, but a number of papers were prepared, and by the end of the year material for two new issues was almost ready for the printer.

The Director continued to edit the horticultural section of the M. A. H. A. Magazine, contributing articles to each of the four issues. Other articles were also contributed by Mr. F. Flippance and Mr. J. C. Nauen.

The Director assisted to edit the Malayan Orchid Review, Vol. 2, No. 3 and contributed articles, one of them describing three new orchid hybrids. Mr. J. C. Nauen contributed an article on hybrid seedlings raised at the Gardens.

PLANTS OUTWARDS AND INWARDS

OUTWARDS :—

Singapore:—

Plants sold	569	
Tubers, suckers, cuttings, etc. sold ...	6,196	
Seeds sold	224	packets
Plants, tubers, etc. sent on exchange ...	353	
Plants, tubers, etc. supplied free ...	1,350	
Seeds supplied to other botanical institutions	516	packets

Penang:—

Plants, tubers, etc. sold	3,707	
Seeds sold	127	packets
Plants, etc. supplied free and on exchange	1,855	
Seeds supplied free or on exchange ...	17	packets

INWARDS :—

Singapore:—

Plants collected by staff, about ...	200	
Seeds collected by staff, about ...	100	
Plants received as gifts or exchange ...	560	
Seeds and bulbs received as gifts or as exchange	580	
Plants purchased	205	
Bulbs purchased	1,000	
Seeds purchased	324	packets

Penang:—

Plants	443	
Seeds	256	packets
Bulbs and cuttings	162	

The gift of plants and seeds from the following is gratefully acknowledged :—

Singapore:—Messrs. Sutton & Sons (Reading), The Conservator of Forests (Johore), Mr. Chan Choi (Singapore), The Department of Agriculture, (S. S. & F. M. S.), The Forest Research Institute (Kepong), Mr. Mungo Park (Kuala Lumpur), Mr. Ee Hup Teck

(Singapore), Mr. W. J. C. Frost, Mrs. Mawson (Singapore), The Manager, Bukit Kajang Estate (Malacca), Mr. W. E. Rigby (Singapore), Dr. W. T. Quaife (Cameron Highlands), Mr. H. S. Tan (Singapore), Mr. G. Veeragoo (Singapore).

Penang:—Mr. Beng Sian (Singapore), Mr. Sanders (Kulim), Mr. W. J. C. Frost, Lt.-Com. J. H. Owen (Penang), Dang Toi Nursery (Bangkok).

Seeds and plants were received on an exchange basis from the Botanic Gardens at Rio de Janeiro, Cienfuegos (Cuba), Hongkong, Nanking, Bonn, Basle, Paris, Oslo, Dresden, La Mortola, Lyon, Duisburg, Uppsala, Edinburgh, Trinidad, Cambridge, Glasnevin, Leningrad, Taihoku, Rabaul, Saigon, Canton, the Royal Gardens, Kew, and the Boyce Thompson South-Western Arboretum (Arizona).

A local exchange of unusual interest and value resulted in the acquisition of a plant of *Adenium coëtaneum,* a very beautiful East African species which appears well suited to pot cultivation in Singapore. This species was brought to Singapore by one of the Japanese ships calling at East African ports. Another African plant which has arrived here in the same way is the orchid *Ansellia nilotica* which has not been very successful. A curious epiphytic bromeliad, *Acanthostachys strobilacea,* also found its way to the garden of a local flower dealer from South America in a similar way.

THE BOTANIC GARDENS, SINGAPORE

Near the Main Entrance, the old trees of *Saraca declinata* and *Brownea capitella* had to be removed, as they were unsightly. Two new Canna beds were made in their place, thus completing the vista of Cannas as seen from the Entrance. New plants of Saraca and Brownea have been sited elsewhere. Behind the Canna beds, on lawn B, the collection of Bougainvilleas has been increased by addition of all remaining varieties, the newer kinds being duplicated. The plants put out last year have continued to do well, espcially *B. formosa.* In combination with the Cannas, they already make a fine colour display. A new and distinct pale mauve Bougainvillea, much smaller than *B. formosa,* was acquired from a local nurseryman; it will probably be a small bushy plant. B. Mrs. Frazer has grown strongly but flowered only moderately. It has flowered much better in a large pot and should be more used in this way, as it is a very fine variety.

Araucaria brasiliana has been added to the collection of conifers, and the young plants have made good growth. Other conifers newly planted are *Cupressus Benthami* and *Thuja orientalis* var. *compacta* and var. *elegantissima.* The two *Pinus Merkusii* planted at the end of 1935 made quite good growth. The *Cupressus* seedlings from Peradeniya seed (*C. macrocarpa* and *C. knightiana*) are unequal in growth and a few of them are looking sickly. The general condition of the group of conifers is however good and it is surprising how many of these plants will tolerate the Singapore climate, though few ever produce seeds. A further small collection of Japanese conifers was received from the Municipal Park, Osaka, as an exchange; these have nearly all made good growth in pots and will provide a useful display for the plant-house.

The avenue of Sealing-wax palms *(Cyrtostachys lakka)* forming part of the Lower Ring Road was replanted. The palms were right against the roadside drains and some were in poor condition. They were all transplanted further back from the road, some divided, and the spacing made even. It is surprising that such large plants can be transplanted without injury, except the death of some of the taller stems.

The new pergola on the Bandstand Hill was planted with climbers, and a mixed border of flowering shrubs and herbaceous plants made on each side of it. By the end of the year the climbers had made good growth and several were flowering, *Bougainvillea Cypheri* being particularly successful. *Jasminum rex* has also made good growth. The shrubs round the outer path of the Bandstand Hill were re-arranged, complete collections of the species and varieties of Panax, Acalypha, Jatropha, Lantana and Brunfelsia being planted together. A further new Lantana called "Drap d'Or" was introduced from Hong Kong. The various Oleanders were grouped beside the road from the Bandstand to the Potting Yard. Among them are two newly introduced varieties from Queensland; these have made very good growth but have not flowered.

Crazy paving was laid in the centre of the small Zephyranthes terrace. with the object of displaying the use of the small plants which have grown so successfully in the crazy paved paths at Government House. A beginning was made with the re-planning of another terrace, but this was not concluded before the end of the year. The plans include the re-making of two flights of steps in better design and less steeply graded, the building of a low wall up to the next terrace, and the re-arrangement of beds. This will allow the effective display of more flowering shrubs of groups still not well represented in the Gardens.

About a dozen more species of the ginger family, several species of Curculigo, and several kinds of small forest shrubs were planted in the Gingerwort Rockery. The plants added to the rockery in 1935 have done well, and the collection is now a very interesting and representative one.

Buildings, etc.—The roofs of the Plant Houses were renewed by the Public Works Department during the year, and the office buildings repaired generally. The pumping engine, which for nearly 30 years has been used to supply water from the lake for the Potting Yard, Plant Houses and Bandstand Hill, being no longer serviceable, was renewed, also part of the piping. Two new concrete tanks for water plants were made in front of the Plant House.

New planting.—The following species of woody plants, of recent introduction, were planted out during the year :—

TREES :—

Ardisia sp.—Johore
Baccaurea reticulata—Jerantut
Barringtonia Scortechinii—Johore
Bertholletia excelsa—Singapore
Calotropis gigantea—Singapore
Croton glabellus—Br. Honduras
Cryptocarya 28435—Johore
Diospyros 28701—Johore
Dolichandrone Rheedii—Singapore
Dryobalanops camphora—Johore
Dysoxylon sp.—Singapore
Dysoxylon 28989, 29247—Johore
Elateriospermum tapos—Batu Gajah
Endiandra praeclara—Johore
Ervatamia corymbosa—Singapore
Ficus sp.—Cameron Highlands
Ficus tonkinensis—Saigon
Flacourtia—Alor Star
Garcinia Gaudichaudii—Johore
Guettarda speciosa—Singapore
Heritiera littoralis—Singapore
Hopea mengarawan—Kepong
Horsfieldia amygdalina, brachiata, lehmanniana—Johore
Knema Cantleyi, intermedia, malayana—Johore
Leptonychia glabra—Johore
Lophopetalum sp.—Penang
Mangifera cæsia—Singapore

Mangifera sp.—Kelantan
Meliosma nitida—Johore
Mimosops Schimperi—Egypt
Myristica Maingayi—Pangkor
Oroxylon indicum—Jerantut
Parkia 31644—Grik
Pachylobium edulis var. mabufo —Belgian Congo
Pasania kunstleri—Johore
Payena sp.—Mandai Road
Pimeliodendron sp.—Johore
Platea latifolia—Johore
Saraca sp.—Borneo
Slœtia sideroxylon—?
Stemonurus scorpioides—Johore
Styrax sp.—Jerantut
Styrax sp.—Kemaman
Swintonia sp.—Johore
Taraktogenos ilicifolius—P. Tioman
Terminalia phellocarpa—Johore
Trigonachras acuta—Singapore
Xylopia sp.—Kemaman
Xylopia sp.—Pahang.

SHRUBS:—Alstonia venenata (Bermuda), Aegiphila monstrosa (British Honduras), Beloperone guttata (Bermuda), Bougainvillea Crimson lake (Penang), Bougainvillea glabra, dark variety (Penang), Bougainvillea Louis Wathen (Sir A. Caldecott), Bougainvillea glabra, pale variety (local purchase, origin Java), Brownea capitella, Brunfelsia Sieberi (Hongkong), Centropogon Lucyanus (Kew), Cratoxylon pruniflorum (Mamyo, Burma), Dombeya spectabilis (Penang), Gardenia florida var. (Kew), Gardenia regina Eleana de Savoie (Kew), Jatropha gossypifolia (Local), Jatropha pandurifolia var. (Mr. J. M. Jackson, Singapore), Lantana Kisii (Berlin), Malvaviscus Conzatii (Hongkong), Myrtus communis (Penang), Nerium oleander splendens (Queensland), Nerium oleander souvenir de Cazalis Allut (Queensland), Nerium oleander white (Penang), Nerium oleander pale pink (Singapore), Ochna mosambicensis (Trinidad), Ouratea stenobotrys (Brit. Honduras), Petrea arborea (Trinidad), Solanum sisymbrifolium (Basle), Tibouchina semidecandra (Penang), Wrightia coccinea (Dehra Dun).

CLIMBERS:—Aristolochia gigas v. Sturtevantii (Trinidad), Clematis dioica (British Honduras), Chonemorpha macrophylla (Dehra Dun), Jasminum rex (Kew), Pandorea australis (La Mortola), Pandorea jasminoides (Government House), Pandorea Ricasoliana (Government House), Stigmaphyllon periplocifolium (Cuba), Thunbergia coccinea (Vilmorin), Triopteris jamaicensis (Cuba).

CONIFERS:—Araucaria brasiliana (Vilmorin), Cupressus Benthami (Mexico), Glyptostrobus pensilis (Canton), Thuja orientalis var. compacta (Nanking), Thuja orientalis var. elegantissima (Berlin).

MISCELLANEOUS:—Oreodoxa borinquena (Trinidad), Pandanus bidur (P. Tioman), Pandanus sp. (Mengkuang Gajah, from Mawai).

The trees in the list of new planting are very largely raised from seeds collected locally by Mr. CORNER, and add considerably to our collection of local plants. Mr. CORNER'S travels have also added other kinds of plants to the Gardens, notably gingers, wild bananas (of which we now have all known local species in cultivation), and epiphytes such as Dischidia, Hoya, Vaccinium and Pandanus, chiefly from the Johore forests. The two epiphytic species of Pandanus are of great interest, the larger one (*P. epiphyticus*) having apparently a restricted distribution in Johore and Borneo. The smaller species, which is more widespread, has not yet been named; flowers of it have now been collected for the first time in Malaya.

Aquatic plants.—The construction of two new concrete tanks in front of the plant house has made more room for aquatic plants; the old tanks inside the Plant House are too shady for most of them. Useful additions to our collections have been *Sagittaria montevidensis, Hydrocleis nymphoides,* some new Nymphæas, and a member of the family Pontederiaceæ received from British Honduras, wrongly named as a Sagittaria. *Sagittaria motevidensis* flowers freely. The Sweet Flag *(Acorus calamus)* and some local aquatic sedges have also been grown successfully. The Chinese Horn-nut *(Trapa bicornis)* grew well and produced one good fruit. The Flowering Rush *(Butomus umbellatus)* has grown only to about half its normal size and has not flowered; the same remark applies to the common Arrowhead *(Sagittaria sagittifolia).* The unknown Pontederia above mentioned is a very large and vigorous plant. The Chinese Water-Pine *(Glyptostrobus pensilis)* being a swamp plant, has been put into one of the tanks, and has made some new growth.

Herbaceous plants.—The only notable addition to our herbaceous plants during the year is a variety of *Cuphea miniata,* received through Mr. B. A. LOWE of the Department of Agriculture. This is a very free-flowering plant of unusual and attractive colour, easily propagated from cuttings. It succeeds best as a pot plant, in well drained soil, in full sun. The violet which someone has introduced to Cameron Highlands was brought to Singapore by Mrs. C. G. MAWSON who gave a plant to the Gardens. It proves easy to grow, and flowers quite freely; the variegated (unfortunately scentless) flowers are very attractive. A number of Chrysanthemum varieties introduced from Japan have not been very successful; many of them succombed during the wet weather from October to December. A quantity of Gladiolus corms were purchased from Europe for use at Government House and at the Gardens; these were very successful. Some perennial Phlox, introduced from Kew at the end of the year, began to make good growth, and it is hoped they will do well. Some new Gerberas, raised from seeds kindly supplied by Dr. JACKES (Queensland) have done well, and include beautiful new shades of colour.

New Shrubs.—The most striking new shrub to appear during the year was *Adenium coëtaneum,* an East African species, of which a plant was acquired by exchange with a local nursery. Adenium has the appearance of a miniature Frangipanni, with a very thick fleshy stem, and seems best grown as a pot plant. Its flowers are strikingly beautiful, and frequently produced. Some Japanese shrubs, in pots, have been grown for a year, but many of them have not been very successful. Among them the Meiwa Kumquat has flowered and fruited well, and makes a handsome foliage plant; if grafted on to a local stock it should be very useful. Some Azaleas have grown quite well in pots, and have flowered occasionally but not very freely. A deciduous Azalea, imported from Japan in a resting condition in February, flowered very beautifully in March, and then made good leaf growth; it flowered again a little in November and December. *Phaleria Blumei,* which has been in the Gardens for many years in a border where it was covered with other bushes, was transplanted to a separate bed where it grew well and flowered several times. Its beautiful pure white flowers are quite reminiscent of a Daphne, and its red fruits are also attractive; it is worth planting more frequently. *Tibouchina semidecandra* has grown fairly well but flowered little.

New Climbers.—The Chinese *Bauhinia corymbosa,* received by seed some years ago from Honolulu, flowered for the first time in August 1936. It had made very good vegetative growth and its foliage is very attractive, but the flowers were only few in number. Possibly it will never flower well in Singapore but it should be tried at the local Hill stations. *Pandorea Ricasoliana,* an African species the local introduction of which is unrecorded,

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was brought by H.E. the Governor from Fraser's Hill. It grew well, flowered freely, and is one of the most useful of the semi-woody flowering climbers. *Clematis dioica,* introduced from British Honduras, grew strongly on the Pergola, but has not yet flowered.

Losses.—The most serious losses of trees during the year were in the neighbourhood of the Aroid Rockery and Potting Yard. A fine *Alangium Ridleyi* was blown down in a storm, its roots rotten with Ganoderma, and caused a serious gap in the shade of the rockery. A large oak beside the potting yard involved other trees in its fall and did a good deal of damage to the Carpenters' Quarters; one of the other trees involved was our finest specimen of *Castilloa elastica.*

Orchids.—The collection of orchids was maintained in fair condition, and a number of new seedlings raised. Additional bench space was provided at the Director's house by the reconstruction of existing staging under the front of the house. The young seedlings in the potting yard still occupy space which is really needed for ferns, begonias, etc., and another house to accommodate them more adequately is much to be desired. The growing of seedling plants was improved by keeping the plants more moist, by cleanliness of potting material, and by allowing the young plants to remain in the flasks to as late a stage as possible.

The beds for Vandas, Arachnis, etc., above the Sun Rockery were re-made and arranged according to a better plan. Thrips continued to give much trouble; their control is the principal problem in the cultivation of this class of orchid in Singapore. The Renanthera collection was increased by the gift of some plants of *R. coccinea* brought from Indo-China by Mr. W. J. C. Frost; we shall be interested to see how these compare with the local garden strain of *R. coccinea,* the origin of which is unknown, and the other variety from Lower Siam.

Seedlings of *Arachnis Hookeriana* × *A. flos-aeris* (the white and common scorpion orchids) flowered for the first time during the year; the flowers proved to be hardly distinguishable from *A. Maingayi,* which is thus shown to be a natural hybrid. *Arachnis Hookeriana* × *Renanthera coccinea* (Lower Siam variety) also flowered and proved to be closely intermediate between its two parents; it was described in the Malayan Orchid Review as Aranthera Mohamed Haniff. Mohamed Haniff was on the staff of the Gardens Department for 36 years and collected the Lower Siam variety of *R. coccinea* which was the male parent of the hybrid. The hybrid inflorescence ascends obliquely (one parent has erect, the other horizontal inflorescences) and bears flowers of a good form, purple pink on a cream background, giving a general effect of brick red. The *Spathoglottis Veillardii* × *affinis* seedlings reported as flowering in 1935 continued to flower freely. The hybrid was named Jubilee (as it first flowered about the time of the Jubilee of H.M. King George V) and described in the Malayan Orchid Review. The flowers on different plants show a great range of colour, though all are closely similar in form. The yellow and mauve colours of the two parents are present in varying intensities and combined together in varying degrees, so that some flowers are salmon-orange, some almost yellow, some mauve, these colours varying in intensity down to very pale shades which are not worth preserving. The habit of the hybrid inflorescence is erect, which is a form new to cultivated Spathoglottis. Another Spathoglottis hybrid flowered during the year but has not yet been named. It is *S. plicata* var. *Parsonsii* (a natural hybrid from the Philippines) × *S. plicata* Penang White. The flowers of this hybrid have various shades of a pretty rose-pink, with deep yellow calli and side-lobes to the lip. It is by far the best pink colour so far seen in local Spathoglottis.

THE WATERFALL GARDENS, PENANG

Development of Section V.—The formal garden already constructed in this section was opened to the public by suitable re-arrangement of the bamboo hedge beside the entrance gate, and the construction of steps to approach the gate. This secluded garden strikes quite a new note, with its tall trim bamboo hedge, carefully planned paths of crazy paving, large water lily tank, formal flower beds of dwarf shrubs and herbaceous plants, pyramidal conifers in concrete pots, and seats for visitors. The addition of a fountain in the water lily tank was made possible when the new water supply was laid, as described below. The garden was designed by Mr. FLIPPANCE, and constructed under his supervision.

Leading on from the formal garden is a larger area for the development of which a sum of $2,000 was entered in the Estimates for 1936. This sum was spent, and the greater part of the development scheme carried out under Mr. FLIPPANCE's supervision. The full scheme consists of a raised terrace, with centre pavilion and pergola extending along the whole of the back, at the far end of the area, approached by a grassy walk (300 ft. long) flanked by herbaceous borders; half way along, the walk is interrupted by an oblong lotus tank 30 by 10 feet, and the borders curve outwards to surround this. The borders are to be backed by a line of concrete pillars, connected with chains, for the accommodation of climbers, and it is intended to plant a row of poplar-like trees on either side to complete the vista effect. At the end of the year all the building and concrete work had been completed except (1) the roof of the pavilion, (2) the paving of the terrace and a small court in front of it, (3) the pillars and chains for the climbers. This is the largest piece of development work to be carried out in the garden for many years. It represents an attempt to apply modern ideas of garden planning to tropical conditions. The work was carried out entirely by the gardens staff with the assistance of one skilled mason. In addition to this masonry work, the vote provided a new water supply from the water lily pool in Section R. This provides necessary water for the water lily and lotus tanks and their fountains, and also for watering of plants generally. In laying these pipes, provision was made for supply to a proposed smaller tank in the Formal Garden, to accommodate smaller aquatic plants.

Lily Pond Gully.—The path on the western side of the gully was taken in hand. A drain was constructed to carry off surface water and the path itself narrowed to 7 feet, with cement bars and steps at intervals to minimise surface wash. The surplus area after narrowing of the path was prepared for planting. This work brings the western path into conformity with the eastern path, dealt with two years previously, and greatly improves the appearance of the gully.

Planting.—Owing to the amount of time devoted to the work already described, it was not possible to carry out much new planting. The following was carried out:—

Section E. Two beds of *Bougainvillea lateritia* (F_2 seedlings).

Section F. One *Pinus Merkusii.*

Section O. A beginning was made in grouping together the Bauhinias, and the following were planted: *B. Kockiana, B. Blakeana, B. acuminata, B. Galpinii* and *B. tomentosa.* In this section also was planted one *Bougainvillea formosa* (origin

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Madras) and four seedlings from the Peradeniya plant of *B. formosa* in Section E.

Section R. Eleven plants *Eucalyptus Naudiniana.*

Section S. *Elæocarpus ganitrus, Nyctanthes arbor-tristis, Lawsonia alba, Guettarda speciosa, Malvaviscus Conzatii, Michælia champaca, Thunbergia Kirkii.*

Masonry.—In addition to the work described above, concrete kerbs were made along several more of the roads. These define the road edges and make the work of keeping them trim much less. The concrete path to the office was re-made.

Seedlings of Bougainvilleas and other shrubs.—In addition to the seeds obtained in 1935, one seedlings has been raised from the Madras plant of *B. formosa,* and two seedlings from a plant of *B. glabra* on Penang Hill. Many seedlings of the F_2 generation of B. lateritia have been obtained.

Some of the seedlings of the Peradeniya plant of *B. formosa* have flowered and have proved to be inferior to the parent plant. The seedlings of Mrs. FRAZER, Rosa Catalina, and the hill *B. glabra* have not yet flowered.

Seedlings of *Holmskioldia sanguinea, Petrea volubilis,* and *Petrea rugosa* have been raised for the first time. These species do not usually produce seeds in Malaya. Among the seedlings of Holmskioldia is some colour variation, three plants showing only a trace of the red colour. Further breeding might produce a good yellow or orange variety.

Anti-malarial work.—Operations of the Health Department were carried out on various ravines round the Gardens to prevent dangerous mosquito breeding. This work occupied the greater part of the year.

GOVERNMENT HOUSE DOMAIN AND OTHER OUTSIDE CHARGES

SINGAPORE

Government House Domain.—As in former years, the maintenance of grounds was carried out by the Gardens Department, Mr. J. C. NAUEN being in charge of the work throughout the year. Improvements were effected in the nursery and potting yard, and in the areas near the House; in the outlying areas, only grass cutting and some attention to recently planted trees was possible.

Along the main drive (Edinburgh Road) twenty badly grown Poinciana trees were cut down and replaced by young plants. The work was thoroughly done, each planting hole being made 8 to 10 feet in diameter and 5 feet deep; a foot or more of drainage material was put into the bottom of each hole and 35 lorry loads of new earth used. The grass verges were renewed in sections.

On the second terrace in front of the House three Livistona palms were removed to allow for the lengthening and symmetrical arrangement of flower borders. These borders were planted with *Russellia sarmentosa, Plumbago capensis, Pentas carnea* and var. *alba,* and *Pentas coccinea,* all being edged with cream Zephyranthes. Beds of *Jatropha hastata* and Crotons were added to the row beside the path circling the tennis courts. The grass verges in front of the House and bordering the main drives on either side of the terraces were replanted and those by the drives also widened and made uniform. Hippeastrum and Zephyranthes bulbs were planted under the groups of Ptychosperma palms. All Cannas were replanted in November. The herbaceous borders were completely replanted and new soil added to the beds. Except for a short period after replanting the borders were maintained in flowering condition throughout the year. The following plants were used : Hibiscus hybrids (red and salmon), *Cassia auriculata, Brunfelsia undulata, Bauhinia acuminata, Gardenia florida, Ervatamia coronaria, Clerodendron Thomsonæ, Russellia sarmentosa, Wedelia sp., Pentas coccinea, Pentas carnea* and var. *alba, Solidago sp., Gerbera* hybrids, *Artemisia lactiflora, Helianthus angustifolius, Asystasia intrusa, Eranthemum Wattii, E. purpureum, E. nervosum, Ixora coccinea. Galphimia glauca, Crossandra undulæfolia, Rudbeckia Newmani, Vinca rosea, Plumbago rosea, Pentapetes phœnicia, Arundina chinensis, A. speciosa, Platycodon grandiflorum, Salvia farinacea, S. splendens, S. coccinea, Dianthus* vars., *Coreopsis Drummondii, C. grandiflora, C. tinctoria* vars., *Zinnia linearis, Torenia Fournieri, Gomphrena globosa, Gynandropsis speciosa, Cacalia coccinea, Gaillardia* hybrids, *Myosotis* sp., *Aster* spp. (perennial), *Cynoglossum* sp., *Phlox Drummondii* vars., *Petunia* vars., *Cosmos sulphureus.* Artificial fertilisers were applied to the tennis courts on six occasions.

The Water Garden, planted in the latter part of 1935, made good progress, the hedge and shrubs becoming well established. Additional plants were periodically supplied as under-bedding and in the crazy paving. A surprisingly large number of small prostrate plants were found suitable for the crazy paving. Most of these were small weeds of lawns and flower beds, some twenty species in all. They adopt a more compact and more prostrate habit under the conditions of the crazy paving, and though their flowers are in most cases small, their variety of form and foliage make a very pleasant effect, when combined with a few species with rather larger flowers. Of the weeds, the more important are species of Fortulaca and Oldenlandia. Of more showy plants, the following proved successful and are really more suited to this type of planting in Singapore than to cultivation in ordinary beds : *Aster bellidioides, Aster* sp. (perennial), *Verbena tenera, Hymenatherum tenuilobum, Portulaca grandiflora, Felicia abyssinica, Salvia farinacea.* A plant of *Victoria regia* was added to the tank and flowered well; also three small varieties of Nymphæa. At the corners of the tank *Cyperus papyrus* was added, also *Monochorea elata* and the Pontederia received from British Honduras as *Sagittaria lancifolia.* The Cannas in the beds on either side of the path approaching the terrace were replaced with Ixoras of various kinds.

In the nursery, a considerable amount of work was done towards a re-arrangement of beds in the enclosed section. The remainder of the climbers were removed, and the space partly used for growing vegetables, the old vegetable plots being used partly for flowers. A number of new banana and papaya plants of several good varieties were planted. Between 300 and 400 additional clumps of Vanda Miss JOAQUIM, 100 *Epidendrum rdicans;* and 100 *Arundina speciosa* were planted, and additional flower beds also made. The stock of Gladiolus corms were harvested and after resting were again planted with excellent results. Some new varieties of Cannas were added.

Additional benches were made for pot plants. The following were added to the list of kinds of pot plants in cultivation : *Sinningia maculata, Bougainvillea* vars., *Galphimia, Angelonia, Tecoma stans, Tecoma capensis,* and various Crotons. The number of pots of annuals and ferns was also increased. The *Arachnis alba* plants were propagated and re-arranged, and the space saved used for planting flowering shrubs to supply cut flowers.

The woodwork of the fern-house roof was renewed by the P.W.D., and wooden staging-supports were replaced by concrete.

It is estimated that 20,000 plants were used in House decoration. Some of the flowering plants were changed on the average twice weekly. The wooden tubs of palms on the verandah in front of the House were replaced by Rhapis palms in concrete tubs constructed at the Gardens.

At the Colonial Secretary's house the garden was maintained as usual. Specimen plants of Bougainvillea, Congea and Petrea were pruned and trained to a more compact form; numerous beds were under-bedded with suitable plants; a new Hibiscus hedge was planted at the lower end of the tennis courts; additional plants of Bougainvillea Mrs. BUTT and OLEANDER were planted; the herbaceous border was re-made, new plants being added; and the cut flower garden was enlarged and enclosed by a Hibiscus hedge.

The wreath of *Hemigraphis colorata* on the Cenotaph was changed every three months.

New Air Port.—A planting plan for the grounds around the entrance to the Singapore Civil Aerodrome was prepared.

Municipality.—Reports on work in connection with Municipal Roadside trees were submitted to the Municipal Engineer weekly. Inspection trips were made weekly by Mr. J. C. NAUEN, accompanied by the Superintendent of roadside trees. During the year numerous trees were cut down at various points and in most instances were replaced with trees of a similar species. The species *Cassia siamea* was discarded as being unsuitable for roadside work and extra care was exercised in the planting of *Spathodea campanulata* only in such places as gave ample space for root development. Pruning operations were handled with more skill, a definite plan of operation being adhered to, especially with young trees.

The maintenance of Woodleigh Nursery was greatly improved. Seedlings were handled with more care, plants were trained and staked from the seedling stage and the ground kept well cultivated.

The following roads were newly planted :—

Braddell Road—*Eugenia grandis.*

Changi Road—*Poinciana regia* and *Bauhinia monandra.*

Holland Road—*Cassia nodosa.*

Corner of Cavanah Road and Clemenceau Avenue—Angsana and Bougainvillea.

Balestier Road—*Lagerstrœmia* and *Peltophorum ferrugineum.*

Henderson Road—*Cassia multijuga.*

Grove Road—*Cassia multijuga* and *Nerium Oleander.*

Farrer Road—Tembusu.

Raffles Square—*Eugenia conglomerata.*

In addition, the following planting work was done :—

1. Alexander Road Sewage disposal works : a screen of miscellaneous trees were planted on the Henderson Road and Tiong Bahru Road sides.

2. The open space at Cecil Street was lined with a planting of *Canarium rufum.*

3. At Finlayson Green, a rearrangement of the planting was made; the existing *Ficus religiosa* were removed and additional trees of *Cassia multijuga, Cassia nodosa* and *Lagerstrœmia flos-reginæ* were planted; other plantings were left until such times as the new plants have attained a good size.

4. Farrer Park, Tennis and Badminton court section : This section was planted out with suitable trees, palms, shrubs and hedges.

5. Katong Park: In accordance with a plan submitted, work was begun on a new layout of shrubberies.

6. King George V Memorial Park: Work was begun by digging planting holes at suitable places, and a considerable number of plants were propagated for planting in 1937.

7. Municipal Offices: In accordance with a plan submitted, an arrangement of beds was made in front of the Municipal Offices. The following plants were planted. Vanda Miss JOAQUIM, *Vinca rosea* and var. *alba*, *Crossandra undulæfolia*, *Alstonia venanata*, *Angelonia*, *Verbena tenera*, perennial Asters and *Cæsalpinia pulcherrima*.

Other work.—At the MacRitchie Reservoir 30 Saracas were added to those already planted beside the path at the head of the reservoir, and also 20 *Cassia nodosa*. At the Pierce Reservoir about 100 miscellaneous trees were planted.

PENANG

Bel Retiro.—The garden, and a varied display of pot plants, was maintained as usual throughout the year. It is one of the most attractive gardens in Malaya, and many visitors, both residents and tourists, have taken advantage of H.E. the Governor's permission to visit it. Additional improvements made during the year have been as follows: The Terrace at the south end of the building was grassed and paths made leading to the steps. The plants beside the steps at the north end of the building were renewed, the verges grassed over, and conifers in concrete pots placed at the top and bottom. The paths have nearly all been surfaced with asphalt by the Public Works Department, the necessary preliminary preparation being done by the Gardens Department; this will result in the release of labour from the work of path maintenance to other purposes.

A case of 27 hybrid Rhododendron plants was received from Kew for trial on the hill; these are mostly hybrids of Malayan mountain species which are used for greenhouse purposes in Europe. Three plants have died, and the others have made new growth. The following Australian plants of recent introduction have been planted out and are doing well: *Acacia rostellifera*, *A. cyanophylla*, *Callistemon lanceolata*, *Melaleuca styphelioides*. Seedlings of *Boronia megastigma* have been raised, but growth is slow. Seedlings of *Clianthus Dampieri* (a beautiful New Zealand shrub) died after attaining six to nine inches in height. *Thunbergia coccinea* flowered, but hardly seems sufficiently decorative to be worth cultivating. Three *Clematis Jackmannii* hybrids presented by Lt. Comdr. OWEN, have made good growth and it is hoped they will flower in due course.

Other hill gardens.—At Strawberry Hill, new plants of the common variety of *Juniperus chinensis* of irregular habit were planted in the four central beds to relieve the flat effect and to contrast with the pyramidal Junipers in the outer circle. At the Crag Hotel major operations of re-arrangement had been completed in 1935. The chief additional planting in 1936 was a group of Poinsettia between the entrance terraces and the pot plant nursery. All slopes and terraces seem to have consolidated and no slips occurred during the wet season. The gardens at the Government Bungalows on the hill were maintained as usual. Their re-design has been completed, and only small improvements or changes were made during the year.

The Residency.—As from January 1st, 1936, this garden came under the immediate supervision of the Assistant Curator and the vote for upkeep was transferred to the Gardens Department. For some years past Mr. FLIPPANCE has regularly visited the garden, and he supervised a new planting scheme in 1935. This scheme was added to in 1936 by further planting of some of the new Bougainvilleas, a group of Bauhinias and several Cassias.

Municipality.—The usual inspections of gardens and Roadside Trees were made, reports forwarded and advice given where necessary.

Other work.—Assistance was given with further planting, chiefly of hedges, at the General Hospital staff quarters; the planting carried out in 1935 made good progress. The large Angsanas in front of "A" Block at the General Hospital were pruned under supervision of the Assistant Curator. Advice and assistance were given to the Penang Sports Club (Golf Section) concerning tree planting at the new golf course and various matters connected with the fairway and greens; a complete plan for tree planting was drawn up and the sites marked. Advice was also given concerning the gardens at St. Nicholas Home, the residence of the Municipal President, and various private gardens, also layout and planting at the Scout Headquarters. Assistance was given in the preparation of wreaths for Poppy Day.

BOTANIC GARDENS
SINGAPORE
1947

STRAITS SETTLEMENTS

Annual Report of the Director of Gardens for the year 1937

BY

E. J. H. CORNER,
Acting Director of Gardens, S.S.

Published by Authority

SINGAPORE:
Printed at the Government Printing Office, Singapore,
by W. T. Cherry, Government Printer.

1938

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ANNUAL REPORT OF THE GARDENS' DEPARTMENT, STRAITS SETTLEMENTS, FOR THE YEAR 1937

By E. J. H. CORNER, *Acting Director of Gardens, S.S.*

STAFF

Several changes affecting the European staff occurred during the year as a result of which two duty-posts in Singapore were vacant throughout. The retirement of the late Mr. G. A. BEST, Assistant Curator of Gardens, Singapore, became effective on August 30th, after leave dating from February 12th; at the end of 1937, it was learnt with deep regret that Mr. BEST had died on October 21st at Bournville, England, after being injured in a street accident. Mr. J. W. EWART was appointed from the Royal Botanic Gardens, Kew, to the post of Assistant Curator of Gardens, Singapore, and arrived in the Settlement on October 9th. Until this date the duties of Assistant Curator, Gardens, were shared by Mr. E. J. H. CORNER, Assistant Director, and Mr. J. C. NAUEN, Assistant Curator, Parks. On October 8th Mr. R. E. HOLTTUM, Director, proceeded on leave and Mr. CORNER was appointed Acting Director.

Mr. F. FLIPPANCE, Assistant Curator of Gardens, Penang, went on leave on February 26th and on December 19th he was appointed Superintendent, Gardens and Forestry Department, Hongkong. Mr. FLIPPANCE, who was appointed to the Gardens' Department in 1919, had been in charge of the Waterfall Gardens at Penang since 1921. On February 27th Mr. M. R. HENDERSON, Curator of the Herbarium, was transferred to Penang and took charge of the Waterfall Gardens throughout the year. The duties of Curator of the Herbarium were shared by Mr. CORNER and Mr. C. X. FURTADO, Assistant Botanist.

Other members of the staff were on duty throughout the year.

LABOUR

The labour-force at Singapore and Penang remained approximately the same as in 1936: 85 labourers were employed at the Botanic Gardens, 57 at Government House Domain, and 54 at the Waterfall Gardens. In accordance with the Government regulations, the rates of pay were altered from the first of January. The minimum rate was increased from 47 cents per day to 50 cents per day: a rise of two cents per day was given to labourers with five or more years service and an extra two cents per day to labourers for whom no quarters could be provided. The health of the force was generally satisfactory, though two cases of chronic malaria occurred in Singapore.

REVENUE

The revenue from the sale of plants, etc., was as follows:—

	$	c.
Singapore:—		
Sale of plants and seeds	1,786	63
Inspection fees, etc.	335	98
Municipal Contribution	2,300	00
Penang:—		
Sale of plants	595	91
Sale of Guides	8	70
Municipal Contribution	1,200	00

The Municipalities of Penang and Singapore paid $100 p.m. for the services of the Assistant Curator, Penang, and the Assistant Curator of Parks, Singapore, respectively, for advice regarding the planting and maintenance of roadside trees. In Singapore, an additional contribution of $100 p.m. was made from January 1st for advice on the planning and supervision of planting in the Municipal Parks.

PLANT COLLECTIONS AND FIELD EXCURSIONS

The collecting of specimens was pushed forward to the utmost extent. About 2,500 field-numbers of plants were obtained and nearly 500 unnumbered specimens. The material will be worked through gradually as the intensive study of the flora progresses in the next few years. It is realised that the systematic work on Malayan flowering plants must now take the form of critical revisions of every genus in order that the description of the Malayan flora may be brought into line with that of neighbouring countries and in order that defects in knowledge may be detected and made good. Especially is this important in the study of forest-trees the majority of which are imperfectly known. Apart, therefore, from the many novelties which such an accumulation of specimens must reveal, it is necessary for the proper description of the recognised species and for the study of their variation and distribution. Considering also the complexity and richness of the Malayan forest-flora and the ease with which it may be destroyed, it is impossible at present to make too many collections. As regards the study of the forest-trees, it is gratifying to be able to record that through the collaboration of the Forest Department a comparatively cheap and effective method of collecting has been started by which native-collectors can be sent for several weeks to places where felling is in progress and the "spoils" of the expedition can be divided to the benefit of both Departments.

On April 18th Mr. CORNER went for three weeks to Kelantan and Trengganu to study the village trees in the neighbourhood of Kota Bahru and Kuala Trengganu; even in the populated areas many interesting discoveries were made. The laurel-tree (*medang*), for example, so abundant round Kota Bahru and the timber of which is used in the construction of the Malay houses, is evidently an undescribed species of Litsea : by the Sultan's residence at Tumpat there grows a tree of Artocarpus of a species new to the flora : the village *kandis*, which occurs also in Kedah and Perlis, is the Indian *Garcinia Cowa*, also unrecorded for Malaya : and, most remarkable, the Annonaceous tree, *Alphonsea elliptica*, which has been supposed very rare, is almost if not quite the commonest fruit-tree at Kuala Trengganu. Like so many of its family it is called Pisang from the bunches of fruit which suggest dumpy bananas : and the school children laughed that there should be anyone not knowing it. In this town also there are many fine specimens of *Chengal Pasir, Hopea odorata,* it being the only place in Malaya where a dipterocarp is grown as a village-tree, though the same species has been planted for an avenue at Saigon. What is probably the best collection of trees of Meninjau, *Gnetum gnemon,* in the East is to be found also in the kampongs of Kuala Trengganu. The flora of both these States, but especially that of Kelantan, contains a large number of plants of the monsoon-climate of Burma, Indo-China and Siam and this influx was found by no means identical with that in Kedah and Perlis. The common *Lagerstrœmia floribunda, Albizzia lebbek, Terminalia pyrifolia* (*mentalun*) and Corypha-palm of Kedah, for instance, are absent from Kelantan, whereas *Vanguieria spinosa* and a species of Sapium which are common near Kota Bahru have not yet been discovered on the West side, the flora of which is much better known. Mr. Corner also studied the local names of the common trees which differ in these States remarkably from the vernacular names in other parts of the country. Thus the mangosteen is called "mesetor" or "sementah", the tamarind "chelagi", the cashew-nut "keterek", *Eugenia grandis* "jembah" or "ubah", *Calophyllum inophyllum* "paku achu" and *Gluta renghas* "jintun". One hundred and forty-one field-numbers were obtained.

In August Mr. Corner took two plant-collectors to Fraser's Hill during his local leave. With the aid of these and of his botanical monkey (*see* below) it was soon discovered that there was still a great deal of botanising to be done before the flora of even this hill-station might be adequately known. By the Gap a large "strangling fig" was discovered which proved to be *Ficus juglandiformis* known only from one or two old collections from Sumatra. The wild *chempedak* or *bankong*, which has never been described botanically, was common by the road to the Dairy Farm. And several new or rare Euphorbiaceous trees were found. Ninty-seven field-numbers were obtained.

In September, at the invitation of Captain A. T. A. Ritchie, Chief Game Warden, Federated Malay States, Mr. Corner joined him in an expedition to the summit of Gunong Tahan. The party left Kuala Tembeling on September 6th and returned on the 18th, after spending four nights at the Padang-camp. Through the necessity of travelling light, big collections could not be made, but about 400 unnumbered specimens and 200 spirit-specimens were obtained. Living plants of *Livistona tahanensis, Pandanus Klossii,* a many-hued Nepenthes, and a wondrously large-flowered *Tacca cristata* were brought back to Singapore. Attention was given mainly to the characteristic plants of the riverside, ridges and padang and, especially, to the conifers. It was found that *Podocarpus deflexus,* known only from the padang of Gunong Tahan, was so abundant that it could be regarded as codominant with *Agathis flavescens* in the uppermost forests. Mr. Corner's conclusions agreed with those of Mr. Ridley's that the Agathis was a "good", endemic species. Further, as a result of the expedition, it was found necessary to distinguish a new species of Dacrydium and to revise critically the other Malayan species which in the herbarium had become sadly mixed. The sight of the vast moorland of Gunong Tahan, on which the climber breaks after threading the steep defile of Tangga Duabelas, is the most remarkable that can greet the eyes of the botanist in all Malaya —the open fields, one may say, above the forest. And when he has enjoyed the easy collecting on the padang and, on his return, peers again into the mysterious Teku-gorge filled with its ocean of trees in stupefying variety, he realises the boundless task ahead : for more than one life-time will be needed to complete the botanical exploration of the National Park.

The watershed of the Sedili River in the East of Johore continued to provide plants of great interest. Mr. Corner paid several one-day excursions to the district and in June the Director and Mr. Corner had the pleasure of taking the famous botanical explorer, Captain F. Kingdon Ward, to the Sedili the wild beauty of which so near to civilisation is always refreshing. In March a plant-collector was stationed for two weeks at the Sungei Kayu Saw Mill to take advantage of the tree-felling : he made a valuable collection of some 130 numbers.

In May a small party, consisting principally of Mr. L. Moysey and the first plant-collector, Kiah, was organised to visit Gunong Padang in Trengganu. The object of the expedition was to make a preliminary survey of the vegetation in the upper part of the mountain with a view to further exploration, and also to add another locality of intensive collecting to the little known interior of the East Coast between Kuantan and Besut. Mr. C. F. SYMINGTON, Forest Research Officer, Kepong, had visited Gunong Tapis in 1934 and Mr. CORNER had studied the lowland forest round the Sungei Nipa, a tributary of the Kemaman, in 1935. From the reports which had been circulated about Gunong Padang it appeared to offer a moorland vegetation similar to that on Gunong Tahan but at the remarkably low altitude of 4,000 ft. Mr. MOYSEY had visited the district in the previous year during his work in the National Park and his services were obtained through special permission of the Straits Settlements Government. The expedition left Singapore on May 22nd and returned on July 15th. Three weeks were spent near the summit of the mountain. About 600 numbers of plants were obtained as well as a large collection of spirit-specimens and many excellent photographs of the vegetation. The examination of the results of the expedition has been only cursory but it has shown that, if there is little true padang or heath-formation, the plateau of the mountain is an almost continuous low wood of Leptospermum, Bæckia and Dacrydium such as one encounters about an altitude of 5,000 ft. on Gunong Tahan, and that numerous plants supposed to occur only on Gunong Tahan are to be found also on Gunong Padang. Indeed, the results of the expedition will give much support to the theory that there was formerly a high quartzite plateau connecting Malaya, Borneo and, perhaps, Sumatra and that of this plateau there remain now in Malaya only the Tahan-massif and its neighbouring mountains dissected by the tributaries of the Pahang, Trengganu and Kelantan, and such outlying monuments as Gunong Kerbau to the West and Gunong Kajang in Pulau Tioman and the cone of Pulau Tinggi to the East. The former height of the plateau may be gathered from the amount of sediment which has built the lowland plains of these three Eastern States.

From May 20th—June 19th, Mr. FURTADO made an excursion down the West side of Malaya for the purpose of collecting palms. He visited Kroh, Baling, Weng, Taiping, Gopeng, Tapah, Bentong, Raub, Gunong Angsi and Gunong Beremban. This was the first opportunity Mr. FURTADO had had of studying the Malayan palms extensively in the forest and he was anxious to try out, under field-conditions, the new proposals for numbering palm-specimens which he had developed the previous year on his visit to the Buitenzorg Botanic Gardens. Palm-collections must be bulky, if they are to be useful, and in the case of rotans the leaves of which vary in shape, size and thorniness along the stems they must comprise so many parts of the plant that botanists have been chary of collecting them or have taken only scraps which are generally unsatisfactory if not misleading. Indeed, palm-specimens are the most difficult to manage because they demand not only an intimate knowledge of the classification of the family in order to know what parts of the giant leaves and inflorescences to select for drying, but much tedious labour in the correct numbering of every part that is taken so that they may not become mixed in the presses. Leather gloves are also needed for the handling of the rotans. If the botanist intends to collect palms, therefore, he must be prepared for comparatively few field-numbers and a large amount of baggage, the quality of the specimens outweighing their variety. Nevertheless, on his excursion, Mr. FURTADO collected about 100 kinds of palm, the total number of specimens separately labelled being nearly a thousand. It will be realised that such a set of palms, which is the first to have been made in Malaya, is worth many times its number of the herbs, shrubs and treelets such as are immediately collected on ordinary expeditions. Mr. FURTADO also took the opportunity of studying the wild aroids: he discovered again *Homalomena elliptica* which had been known only from a single specimen of Scortechini's collected in Perak some sixty years ago. About 136 numbers were obtained in all.

In April, in conjunction wtih the Forest Department, a small party under MOHAMED NUR, Herbarium Assistant at Singapore, was sent for nearly four weeks to Ringlet, Cameron Highlands, to collect during the clearing of some forest on Boh Estate. About 400 numbers were obtained as well as a big collection of wood-specimens and spirit-specimens. The results will afford a valuable and representative sample of the mid-mountain forest which, lying between the plains and the mountain-tops, has received as yet but scant attention.

In October and November, MOHAMED NUR was again sent off in conjunction with the Forest Department, but this time to collect specimens on behalf of Harvard University, U.S.A. The expedition was undertaken at the request of Dr. E. D. MERRILL, Director of the Arnold Arboretum, and at the expense of Harvard University, for the purpose of supplying the University with abundant material of Malayan plants. MOHAMED NUR visited the Telok Forest Reserve near Klang, the Sungei Tinggi Reserve near Kuala Selangor, Ginting Simpak and Bukit Kanching. About 450 numbers were obtained, a collection of wood-specimens for the Forest Department and another of spirit-specimens for the Botanic Gardens. Most of the duplicate specimens, when named, will be sent to the Arnold Arboretum. Another expedition will be organised in 1938 on the same basis.

For the success of these expeditions special thanks are offered to the following persons:—to Mr. C. F. SYMINGTON, Forest Research Officer, Kepong, for supervising the expeditions led by MOHAMED NUR: to Captain A. T. A. RITCHIE, Chief Game Warden, F.M.S., for providing Mr. CORNER with the opportunity of ascending Gunong Tahan: to the Honourable Mr. N. R. JARRETT, British Adviser, Trengganu, for assisting Mr. MOYSEY'S expedition to Gunong Padang: to the Conservator of Forests, Johore, Mr. H. G. GRIEVE of Tebrau Estate, Johore Bahru, and Mr. HO CHEOW CHAN, Sungei Kayu Saw Mill, for their assistance in the exploration of the Johore Forests: to Mr. F. FAIRLIE, Boh Plantations, Ltd., for accommodating the expedition to Ringlet and allowing the collections to be made on his estate.

BOTANICAL MONKEYS

Toward the end of the year there were added to the collecting equipment of the Department two berok-monkeys (*Macacus nemestrina*), which were kept in the garden of the Assistant Curator's Quarters, Cluny Road, and the second Malay plant-collector, NGADIMAN, was given charge of them.

The berok is the Coconut or Pig-Tailed Monkey which, as is well-known, is widely used in the East by Malays for gathering coconuts. The wild monkeys are caught as young as possible—so small even that they will sit in the hand; and they are trained gradually to twist young fruits off the coconut-inflorescences so that when they have grown strong enough they can climb the tallest trunks and drop the full-sized nuts from the crown. But it may not be so well-known that a few of these monkeys are taught also such other jobs as plucking mangoes or pulling bunches of rambutans from the orchard trees. It seemed possible, therefore, that a monkey so trained would solve even the botanist's problem of obtaining specimens from tall trees, palms and climbers the height of which rendered them inaccessible; for, if the tree cannot be felled—and to cut down a forest giant for the sake of a few twigs is not merely costly but destructive—then one must employ a native climber or use a shot-gun, and both have their limitations. The berok is imperfect, too, because it cannot scale big

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trees unless there are climbers on it or small trees beneath by which it can ascend to the main limbs and overcome the long bole, but the experience of the last year has justified the idea that the berok offers the ablest assistance which the student of trees can have in the high forest. A berok upon the shoulder can be likened, in effect, to a falcon on the wrist; and its employment is recommended both to amateurs for its charm and cheapness and to keepers of Reserves where it is desirable to collect specimens repeatedly from the same trees without damage to them. It must be added that the berok is immune, moreover, to the irritation provoked by *rengas*-sap so that it enables one to collect specimens from these poisonous trees of the Mango-family, so abundant in the forest and yet, through avoidance, so little known.

When Mr. CORNER was in Kelantan in April he was fortunate in finding a young berok which had been educated just as a botanist might wish. This monkey, called Merah, was brought to Singapore and after several weeks' training it complied with every expectation. On one occasion in Johore, for instance, it worked in the crown of a Wild Chempedak at the height of 170 feet: on another day it collected specimens from 24 trees, all of which were over 100 feet in height. At Fraser's Hill it obtained good specimens from five of the giant palms, *Caryota equatorialis*, which seem to have been collected only once before in Malaya, many years ago, and of which there were no specimens in the Singapore Herbarium: it revelled, too, in throwing down fruits from so many plants of a big climbing fig that it was discovered for the first time that the gall-figs of this species (*F. callicarpa* var.) were twice as big as the seed-figs and differently marked. Unfortunately this monkey developed an obscure illness at Fraser's Hill and, though it became a patient at the College of Medicine in Singapore, it had to be put away at the end of September. In its brief career, it had collected specimens from more than 300 different kinds of tree at negligible expense. The technique having thus been proved, the Malay plant-collector, NGADIMAN, was sent to Kota Bahru to find two more such monkeys and to learn how to train them and how to talk to them. After much difficulty he found the two young beroks, Jambul and Puteh, which were purchased by the Department and installed at the Botanical Gardens.

Now the method of collecting by these monkeys is this. They are kept on a string or, in the forest, they would run away. The string, which is 180 feet long, or more if need be, is wound on a wooden frame like a fishing line and is attached by a swivel to a collar round the monkey's neck. One speaks to the monkey in Malay, though in the present case it is "Kelantanese". "Gi ata" one says, and the monkey goes up the tree. Should it climb along a branch not intended, one shouts "Bukan itu, gi ata lagi"; and when it gets to the right branch "Belah itu" and along it the monkey goes. When it reaches the twigs to be collected, one jerks the string and shouts, "Ambil itu" whereupon the monkey pulls back and bites off ("repis itu") a twig and drops it clear. If more are needed, one shouts "Ambil lagi" and the monkey will bite off as many as are wanted. When it has finished, one cries "Turun" and the monkey comes down. But should any twigs in their fall have been caught up among the lower branches the monkey will have noticed and then one says "Turun, pelepas itu" whereon the monkey finds the quickest way to the twigs, lifts them up and drops them clear as many times as may be necessary. A well-trained monkey, when it reaches the ground, picks up the twigs and puts them into one's hand. The twigs which they gather are generally so ample that each can be divided into three or four herbarium-specimens: they do not pull off the flowers or fruits but break off the whole twig from behind the leaves. In the case of trees which flower from the branches, such as durians and wild nutmegs, some patience is needed to teach the monkey to rip the flowers from the branches after having collected the twigs, but as soon as the idea is grasped a rain of blossom descends.

It will be obvious that these monkeys delight in what they are doing: and the more one speaks to them, using the same words, the more they understand. After some practice in the jungle, they do not have to climb every tree but by a series of shouts and jerks on the string and pointing and slapping of trunks they can be induced to free their strings and leap from bough to bough so that they can visit numerous trees before they are obliged to come down for a drink of water. Further, the more practice they get, the more they understand what is wanted and they drop down any arresting objects such as opening buds, flowers, fruits and galls which are invisible from below: indeed, to work with a clever berok in the jungle is like fishing in the tree-tops. At the end of his days, Merah was able to find in the trees flowers and fruits which had been shown to him on the ground: and he knew the meaning of 18 words of Malay. The present pair are by no means so accomplished. They have a vocabulary of only 12 words but they are younger and the one, Puteh, is full of promise. As for their strings becoming tied up through entanglement in the branches or in the stems of climbers, there need be no fear: there is hardly a knot which they cannot undo and once it is loose they pass their bodies through the coils by pulling on the string and following their chins: if need be, they dangle by their necks.

By the end of the year, both monkeys had done considerable work in Bukit Timah Forest Reserve whither the one or the other had been sent every day. The specimens, which they obtained, have already repaid their cost of purchase, the price of such monkeys being about $25. It seems that these two must be congratulated, moreover, on being the first apes to enter Government service.

BOTANICAL RESERVES

As the virgin territories of Malaya are opened up and the forest-reserves exploited, so it becomes desirable that certain small parts of the forest should be preserved, here and there throughout the country, as samples of the natural vegetation. The idea of making small botanical reserves, preferably within forest reserves where they will be in no danger of isolation, has thus gradually developed. Places that immediately suggest themselves are the quartzite ridges at Klang Gates, Kanching and Gunong Panti, Taman Sedia at Cameron Highlands and a forested cove at Lumut or Pangkor. The Gardens Department drew the attention of the Forest Department to this proposal during the year and it is gratifying to be able to record that the following areas have been approved as botanical reserves:—

The quartzite ridge in the Kanching Forest Reserve, Selangor.

An area of Forest Reserve on the right of the main road from Kuala Kangsar to Taiping.

The summit of Bukit Senaling, Negri Sembilan.

The ridge of Gunong Panti in the east of Johore and the head of the Segun valley at the eastern end of the mountain.

An area of 100 acres of swamp-forest by the Sedili River in Johore.

Bukit Timah Forest Reserve (*see* below) and two areas of mangrove forest in Singapore Island.

In respect of the botanical reserves in Johore, the Department was greatly obliged to the Johore Government for its approval of the scheme and for its financial assistance in the demarcation of the area by the Sedili

River, which was in progress at the end of the year. This area, which was selected by Mr. CORNER and approved by the Conservator of Forests, Johore, is a fine example of the freshwater, tidal, swampy forest so abundant in the neighbourhood of Mawai and now being exploited for timber. The swampy forest has been explored by officers of this Department for several years because of its exceptional botanical interest. There occur within it many kinds of tree with stilt-roots and breathing roots, like those of the mangrove trees but belonging to such diverse families as the Annonaceæ, Myristicaceæ, Guttiferæ, Tiliaceæ Celastraceæ, Ebenaceæ, Sapotaceæ, Cupuliferæ and Euphorbiaceæ: most of these plants have never been described systematically or in any way brought to the notice of botanists. The reserve, which lies a short distance above Mawai, includes one of the most beautiful forest-frontages on the river. It will be investigated in detail in the ensuing years.

BUKIT TIMAH FOREST RESERVE

This reserve, of some 250 acres, was taken overby the Gardens' Department in July and is to be held as a Nature Reserve. It covers the greater part of Bukit Timah and can be reached by car in about twenty minutes from Raffles Place. It contains a fine and varied stand of big trees and a steep valley—the Fern Valley—of great botanical interest, the only parallel to which that has been discovered in Malaya being that of the remote Ulu Segun on Gunong Panti. It offers also magnificent views in every direction and for a mammalian fauna it can still boast of lotong and kra monkeys, kubong (flying lemur), pelandok, wild pigs, an occasional tiger and a few small rusa which roam through the Water Catchment Area. Botanically, the preservation of Bukit Timah is of historic importance because its forest has been visited by nearly every distinguished botanist who has arrived in Singapore since its foundation and many new species have been described from specimens gathered in its precincts. But its preservation is more valuable still for the civic life of Singapore because it offers a retreat wherein one can teach the rising generation to have a care for the wild things of wood and water. Except, indeed, a small piece of swampy land on the Mandai Road, and there is no other virgin forest within forty miles of Singapore town.

A patrol of six labourers and one plant-collector was assigned to the reserve: the plant-collector was given the rank of Forest-Ranger. The first activity was to stop thefts of timber which was accomplished by October. Traces for several new paths were cut. The dense growth of ressam on the summit was cleared and the area was grassed over. Some vistas were opened up and three small shelters were erected where broad views could be obtained over Singapore town and the mainland. Collections were made by the botanical monkeys, Jambul and Puteh, from more than a hundred big trees whereby they were identified. Small aluminium labels, bearing both the botanical and vernacular names of the trees and the families to which they belong, were fixed to the trunks. Several kinds of forest Monocotyledon (gingers, aroids, etc.) and tree-ferns were planted where patches of ressam had been cleared away. Many felled trees were tidied up.

Grateful thanks are expressed to Mr. J. HINDHEDE for his help in this work and for permission to make use of his private road.

CLASSES FOR SCHOOL-TEACHERS

At the request of the Inspector of Schools, Singapore and Labuan, Mr. CORNER held an advanced course in Systematic Botany at the Botanic Gardens on Saturday mornings. It was attended by the twelve most successful teachers from the preceding year's elementary course. Thirteen classes were held, each of 1½ to 2 hours, and several excursions to different parts of the island were arranged. These excursions were attended also by the teachers who had joined the advanced class in the preceding year. The classes have shown that there is abundant talent in Singapore for the study and teaching of Biology, not to mention eagerness, if only illustrated books can be prepared as guides and for reference.

HERBARIUM WORK AND OTHER INVESTIGATIONS

Mr. Corner spent the greater part of his spare time working in the general herbarium in continuance of his undertaking to write a book on the common trees of Malaya. It has not yet been possible to cover the whole botanical groundwork for the book on account of the technical difficulties in the botanical nomenclature of the common trees. As the book offers the opportunity of bringing the botanical names of the Malayan trees into agreement with those used by the Dutch botanists in Java, who have given to the subject a great amount of fundamental research, it is important that the errors in Malayan systematy should be corrected as far as possible. The photographs for the proposed book were completed, however, and the blocks will be made in 1938. Mr. Corner also completed his revision of Ficus, subgenus Synœcia, which is a group of some 17 species of climbing figs with very large, beautiful fruits and which is distributed from Burma and Formosa to New Guinea. Special thanks are offered to the Botanical Departments at Buitenzorg, Calcutta and Manila for the loan of specimens for this investigation.

Mr. Furtado carried on the routine of the herbarium in the absence of Mr. Henderson in Penang. He continued his studies on Malayan palms and determined a large number of collections. As palm-specimens are usually bulkier than those of other plants, it has been necessary to order for them large-sized herbarium-sheets, as is also the method at Kew and Berlin. There was a delay in the arrival of these sheets and, therefore, Mr. Furtado transferred his activities to the Malayan aroids. He studied particularly the genus Homalomena which is one of the bigger and more difficult of common aroids in the country. The species appeared to be extraordinarily variable in every character and the variation appeared to depend not only on the age of the plant but on such environmental conditions as soil, exposure, flooding and humidity. The greatest variation was found in species which grew on stream-sides and on rocks in waterfalls where they were subjected to a graded intensity and frequency of flood and spray. These apparent variations had been the basis of numerous species; and the problem was to discover how far they were merely modifications of individuals of the same species under different conditions and how far they should be regarded as hereditary and specific. Mr. Furtado thus found it necessary to combine ecological studies with systematic.

In the cryptogamic herbarium, the Director continued his studies of ferns and prepared for publication a paper on the genus Teratophyllum, thus completing his survey of the climbing ferns of the Malaysian region. This group of ferns has exceptional interest and no general survey of it had been published. Thanks are due to the authorities in charge of the herbariums in Buitenzorg, Manila, Brisbane and Washington for the loan of specimens.

A new exchange of specimens was started with the Director of the Botanic Gardens and Herbarium at Berlin. The Gardens Herbarium received from Berlin about 500 duplicate specimens of Ledermann's collection of plants from New Guinea. This represents about half of the total number of duplicates available from this collection and the other half is being reserved for the Gardens' herbarium when the balance which is now against it shall have been made good. The Gardens' herbarium is very deficient in plants from New Guinea, the only large set which it possesses being the late Mr. C. E. Carr's which is unworked. As Ledermann's collection has been studied by specialists and contains many new species, the acquisition of the duplicates for the Gardens' herbarium is most valuable.

In return for the Department's services in identifying his specimens, Mr. A. Vesterdal of the Danish East Asiatic Company presented to the herbarium numerous specimens collected by him and his assistants from the Chantaboon-district in the east of Lower Siam. The flora of Siam is so closely related with that of Malaya that the two cannot profitably be studied apart yet the Gardens' herbarium is also deficient in Siamese plants. Mr. Vesterdal's gift is therefore much appreciated.

Over 6,500 specimens were mounted and incorporated in the herbarium during the year. Most were from the late Mr. Carr's collections from New Guinea.

Six hundred and twenty-two specimens were sent on loan to the following institutions:—Arnold Arboretum, U.S.A.; Berlin; Buitenzorg; Bureau of Plant Industry, U.S.A.; Kepong, F.M.S.; Kew; Leiden; Paris; and Uppsala. Mr. Symington revised the material of Magnoliaceæ and Polygalaceæ.

Duplicate specimens were distributed in 1937 as follows:—

University, Uppsala	16
University, Leiden	8
Forest Research Institute, Kepong	39
Okiyama Jun., Japan	43
Botanic Gardens, Buitenzorg	246
Botanic Gardens, Kew	264
United States National Herbarium	186
Botanic Gardens, Kyoto	100
Fan Memorial Institute, Peiping	129
Botanic Gardens, Brisbane	80
Bureau of Science, Manila	36
British Museum	64
	1,211

Specimens were received in exchange, as follows:—

Conservator of Forests, Sandakan	589
Botanic Gardens, Buitenzorg	414
Forest Research Institute, Kepong	400
Professor T. Tanaka, Formosa	150
Botanic Gardens, Berlin	500
New York Botanic Gardens	8
A. Vesterdal, Copenhagen	290
Lingnan University, Canton	136
Fan Memorial Institute, Peiping	47
Dr. O. Posthumus, Java	30
Bureau of Science, Manila	36
Professor H. H. Bartlett, Michigan	358
	2,958

In order to store conveniently the duplicates of new and doubtful species collected in Malaya until such time as they could be studied critically, a new kind of herbarium-cabinet was ordered. It was lower than the ordinary cabinet but its width was double so that its relative capacity was increased and bulky parcels could be put on the shelves. One such cabinet would be placed on the top of two adjacent pairs of ordinary cabinets. The excess study-material, then placed in the new uppermost cabinet, would correspond in systematic position in the herbarium with the mounted specimen of the material in the ordinary cabinets underneath. Ten such cabinets were obtained as a beginning.

To facilitate the study of Malayan plants for which dried specimens are inadequate, Mr. CORNER has been making during the last few years a collection of flowers and fruits preserved in spirit. The collection now contains more than a thousand specimens and has become a useful store of reference whenever the revision of some genus is taken in hand.

In connection with the research undertaken in the Herbarium during the year, special thanks are offered to the following persons and institutions:—to the staff of the Royal Botanical Gardens, Kew; of the 'Rijks Herbarium, Leiden; and of the Botanic Gardens, Buitenzorg for help in naming difficult and critical material: to Professor N. E. SVEDELIUS of the University, Uppsala, for his invaluable assistance in solving certain problems concerning Artocarpus and Ficus: to Mr. J. W. GRANT, Rice Research Officer, Burma, to the Deputy Director of Agriculture, Tenasserim Circle, Moulmein, and to the Principal of the College of Agriculture, Coimbatore, Madras, for sending specimens of jack-and chempedak-fruits for a study concerning Artocarpus: to the Principal Agricultural Officers, Kedah and Kelantan, and to Mr. J. N. MILSUM, Senior Assistant Agriculturist, for sending specimens of village fruit-trees.

THE LIBRARY

As in previous years, Mr. FURTADO was in charge of the library but, because the work had increased greatly, he was assisted as far as possible by Mr. J. L. PESTANA, Laboratory Assistant. A few years ago Mr. FURTADO began the compilation of two special indices in addition to the ordinary index of books: one of these covered the recent literature on Malayan plants, and the other the additions and corrections to Ridley's Flora of the Malay Peninsula. Botanical research on the Malaysian flora has increased so much in recent years that the labour of compiling these indices has become correspondingly involved.

Great difficulty has been encountered in protecting the books, which are kept on open shelves, from the attacks of boring beetles and silverfish. Most books were periodically fumigated in batches throughout the year and over one week-end the whole library was sealed and treated with paradichlor-benzene. It was decided that the larger and more valuable books must be kept in closed cases. Accordingly two large, glass-fronted cases with sliding doors were acquired for the library and two smaller, but similar wall-cases were fixed in the herbarium. In these wall-cases many recent systematic works on the Malaysian flora were placed so as to relieve the main library of the congestion on its shelves.

Among the more valuable additions to the library were the following works:—

DON, General System of Gardening and Botany, 3 Vols. (1831–38).

CAMUS, Les Chenes: Tome 1 (1934), t. 2 (1935–36).

FORSTER, Characteres Generum Plantarum (1776).

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FRIES, Hymenomycetes Europæi (facsimile ed 1937).

LAMARCK, Encyclopedie Methodique Botanique, 33 Vols. (1783–1817).

LINNAEUS, Genera Plantarum (1754).

MILLER, Gardeners Dictionary Vols. I, II (1768).

MURRAY, Linnaeus Systema Vegetabilium, ed. XIV (1784).

NECKER, Elementa Botanica et Corrolarium, Vols. I–III (1790–91).

PERSOON, Linnaeus Systema Vegetabilium, ed. XV (1797).

PERSOON, Synopsis Plantarum seu Enchiridion Botanicum Vols. I, II (1805–07).

REID and CHANDLER, London Clay Flora (1933) (presented by the Trustees of the British Museum).

ROXBURGH, Flora Indica, Vol. I (1820).

SARGENT, Plantæ Wilsonianæ Vols. I, II (facsimile ed. 1936).

STEUDEL, Nomenclator Botanicus Vols. I, II (1840–41).

Fifty-five books were bound for the library by the Government Printing Department.

PUBLICATIONS

Two parts of volumes IX of the Gardens' Bulletin were published during the year. Part 2, published on May 4th, contained three papers on ferns by the Director, two on palms by Mr. FURTADO, one on *Euphorbia Ridleyi* by Mr. L. CROIZAT of New York and one on the use of the terms "Malaya" and "Malaysia" by Mr. C. G. G. J. VAN STEENIS of Buitenzorg. Part 3, published on October 9th, contained one large and two shorter papers on botanical taxonomy by Mr. FURTADO. Part 4 was sent to the press at the end of the year.

The Director continued to edit the horticultural section of the M. A. H. A. MAGAZINE, articles to which were contributed by the Director, Mr. FLIPPANCE and Mr. NAUEN.

The Director and Mr. FURTADO contributed short papers to a special issue of BLUMEA (Leiden) in celebration of the 70th birthday of Dr. J. J. SMITH, the famous orchidologist. Mr. FURTADO also contributed two short papers on taxonomy to the Chronica Botanica (Leiden).

Mr. FURTADO'S papers on taxonomy embody a set of criticisms, discussions and proposals for amendment of the International Rules of Botanical Nomenclature. Much difficulty has been encountered in recent years through the endeavour to determine the correct botanical names of Malayan plants by strict application of the International Rules. Mr. FURTADO'S work is valuable because it approaches the Rules from a critical study of tropical plants, the Rules having been framed mainly from the similar but by no means coincident problems of temperate botany.

PLANTS OUTWARDS AND INWARDS

OUTWARDS :—

Singapore:—

Plants sold	5,581	
Tubers, suckers, cuttings, etc. sold ...	4,746	
Seeds sold	137	packets
Plants, tubers, etc. sent on exchange ...	289	
Plants, tubers, seeds, etc. supplied free ...	2,694	
Seeds supplied to other Botanical Institutes	271	packets

Penang:—

Plants, tubers, etc. sold	5,363	
Seeds sold	290	packets
Plants, etc. supplied free or on exchange	746	
Seeds supplied free or on exchange	6	packets
Cuttings supplied free or on exchange	4,661	

Inwards :—

Singapore:—

Plants collected by staff	132	
Seeds collected by staff	44	packets
Plants received as gifts or exchange	227	
Seeds and bulbs received as gifts or as exchange	409	
Plants purchased	111	
Seeds purchased	266	packets

Penang:—

Plants	302	
Seeds	260	packets

The gift of plants and seeds from the following is gratefully acknowledged :—

Singapore :—Department of Agriculture, S.S. and F.M.S., Messrs. Carters, Ltd. (London), Mr. J. Laycock (Singapore), Mr. Lim Hong Hee (Singapore), Mr. H. S. Tan (Singapore), Mrs. Mawson (Singapore), Dr. T. Nishimura (Singapore), Mr. Z. Teruya (Singapore), Mr. T. Takin (Kuala Lumpr), Mrs. William (Johore), Mrs. Edward (Johore), Mr. W. N. C. Steele (F.M.S. Railways), Mrs. F. W. Thompson (Singapore), Mrs. H. W. Shively (Singapore), Mr. E. B. Butler (Kuala Lumpur), Mr. G. Martin (Singapore), Mrs. W. I. L. Legg (Singapore), Mr. G. S. Miller (Singapore), Mrs. W. D. Barron (Singapore), Mrs. van der Reib (S. Africa), Mr. E. Zorinka (Formosa), Mr. C. Ginarajadusa (Madras), Mr. Groneveld (Batavia), the late Mr. W. Cradwick (Jamaica), Dr. E. Rama (Madagascar), Mr. N. E. Shirley (Natal), Mr. D'Barry (Los Angeles), Mr. C. Langbecker (Queensland).

Penang :—Mr. G. R. Mills (Perak), Mr. H. J. Kitchener (Pahang), Mrs. E. B. Butler (Selangor), Mr. J. N. Milsum (Selangor), Mr. J. W. Frost, Mrs. W. M. Thomson.

Seeds and plants were received on an exchange from the botanical institutions at Dehra Dun, Canton, Rio de Janeiro, Berlin, Hongkong, Rotterdam, Florida, Portugal, Formosa, Cuba, Edinburgh, Amani (E. Africa), Kirstenbosch (S. Africa), Madagascar, California, Tokyo, and from the Forest Research Institute, Kepong, and the Istana Gardens, Johore.

At Penang, exchanges were effected with the following persons :— Mr. H. S. Poh (Penang), Mr. F. R. Jew (Penang), Mr. P. P. Bhubal (Siam), Mrs. Ross (Penang), Dang Toi Nursery (Siam), Mr. T. B. Sian (Singapore), Mr. L. S. Lim (Penang).

THE BOTANIC GARDENS, SINGAPORE

The outside work dealt chiefly with general maintenance, the development of the schemes begun in past years and the general cultivation of the more recent plantings. There were, unfortunately, rather heavy losses of big trees so that much time was spent in removing the dead wood. At the close of the year, considerable alterations were made at the foot of the lake in conjunction with the annual lifting and manuring of the Canna-beds.

The first undertaking of the year was to cut the stems of all the climbers in the Gardens' Jungle, which was done methodically throughout. There were many sorts of big climbers in the Jungle, not a few representing rare species, and it was hoped that some might have been selected as specimens, but the tangle of their sprays and the entwining of their stems prevented this. The dying sprays of the climbers soon revealed, as had been expected, that the crowns of many trees had become almost completely smothered: the climbing stems, too, had been encircling many trunks and strangling them. As a consequence the canopy of the Jungle was marred during the year by brown patches of dead foliage through which the emaciated stag-headed crowns of big trees projected, ill-becoming their massive boles. But the canopy will close over in a few years as the trees take new life, and Liane Road will quickly recover its deserts for vigorous shoots are sprouting from the stumps of the climbers.

The next undertaking was to trim the bamboos, the cut bases of the stems of which had been accumulating for a long time and were apt to breed mosquitoes. By judicious thinning the appearance of the big clumps was much improved.

The drain leading from the leaf-mould pit to the lake had gradually become blocked by tree-roots so that after a heavy downpour there would be a sour accumulation of water for several days. The many toads would croak their approval but the drain was opened and re-laid. Great care had to be taken not to injure the roots of the big trees along Tyersall Avenue, and with the excavations extending in places to a depth of eight feet, the tunnelling became a work of art.

The path joining the end of Liane Road with the Potting Yard was given a new bend so as to circumvent two magnificent trees of Shorea between the trunks of which it had been taken some years previously. The trunks and buttresses of the trees had grown so much that they had encroached upon the path and were continually being injured by passing hand-carts. At the same time as the labour-force was concentrated in this spot, the opportunity was taken to remove two large and unnecessary clumps of Bayas, *Oncosperma horrida,* in the neighbourhood. This palm seeds very freely in the Gardens and, like the oil-palm and the kabong (*Arenga saccharifera*), it is to be regarded as a major weed.

The lake was cleaned twice during the year. The growth of weeds, as usual, was phenomenal and in three months after cleaning the water-lilies had begun to be choked. The water-lilies were thinned out so as to space them far apart, for they seed so freely that their growth is soon hampered by parasitic offspring. Moreover, there is a kind of water-maggot that lives on the undersides of the leaves and devours them, and by isolating the plants the ravages of the pest have been appreciably lessened. Of the three plants of the Giant Amazon Water-Lily, *Victoria regia,* none had grown up to its reputation. It was feared lest that they had been planted in too deep water, so two were lifted to the shallower head of the lake where they had produced by the end of the year bigger and healthier leaves. About a dozen new varieties of water-lilies, obtained the previous year from Bangkok, were planted out. They were put in large concrete tubs, perforated for the egress of their roots, with the intention of being able to manure them effectively. The method did not prove very satisfactory: though the plants grew well at first, they soon lost their vigour, perhaps because the roots became asphyxiated or, may be, the initial alkalinity of the tubs had accelerated their growth.

To feed the ducks and fishes by the lake became an increasing attraction during the year. The grass-edge between the mango-trees and the banyan, *Ficus Kurzii,* was worn into an untidy path and the bank above it was trampled too. A new footpath by the lake suggested itself as at once attractive and useful. So, in November, the bank was excavated to make it too steep to walk upon with comfort and along the bottom a laterite path, four feet wide and a foot above the water, was made to follow the edge of the lake. For the approach from the Main Gate Road two flights of brick-steps were set in the bank, and they will serve also as seats from whence one may contemplate the waterlilies in dry weather.

The avenue of kabong-palms, *Arenga saccharifera,* leading from Tyersall Gate to the Palm Valley was reconstructed. Several of the old palms that had died were removed, and the rest must follow their fate in a few years. After much disappointment, for the seedlings have a way of dying unaccountably, an avenue of young palms was established but, to compensate for their slow initial growth, a row of saplings of the Bignoniaceous tree, *Stereospermum fimbriatum,* was planted on each side. From its quick growth and lofty habit, an avenue composed of this species and of kabong-palms will not be unbecoming.

The collection of Hibiscus-varieties was re-organised by Mr. J. L. PESTANA. Sixty-two varieties were discovered in the Gardens. Plants of all these were placed in order in one long bed in the nursery and cuttings of 25 kinds, which had always been in demand, were put into separate beds. In the display of bushes by the Main Gate Road, 25 old plants were removed and new ones substituted, seven of which had been grafted and eight budded on to vigorous stocks.

The collection of Cannas was re-organised by Mr. NAUEN and Mr. PESTANA. Fifty-four varieties were being grown by the end of the year, 19 of which had been recently introduced. In the renewal of the beds by the Main Gate in December, some re-arrangement was considered advisable to show off the colours to the best advantage: a background of sombre foliage, for instance, is becoming to all but especially to the delicate shades. Four beds were closed and four new ones were made. The following were the new varieties obtained during the year:—Flag of Truce, Pride of Kuala Lumpur, Pride of Weld Hill, Mrs. Fierre Dupont, the President, Deep Pink, Johore, Louis Caillaux, Queen Mary, Milsum 1 and 2 (seedlings), Candelabra, Emily Milsum, Ruth Barrow, Copper Giant, Mrs. Hoover, Pestana 3, 4 and 5. The beds were labelled with the horticultural names of the different kinds.

Another group of horticultural plants under consideration was the Ixoras which deserve greater prominence in brightening the big lawns sloping to the Main Gate Road. A new bed of Ixoras was planted just to the right of the main entrance and another oval bed at the foot of the lawn leading to the two mango-trees by the lake. For the same purpose some of the more vigorous and free-flowering varieties of Hibiscus were used to cover the gap created by the loss of the big *Eugenia grandis* by the Dell, though it must be admitted the clearance displayed to advantage the two trees of *Filicium decipiens* in the Dell, the beauty of whose feathery crowns had been entirely hidden.

Among the more important additions for many years to the collections of special plants grown in the Gardens were two consignments of Japanese bamboos, received one in June, the other in December. For these the Gardens Department was indebted to the Department of Civil Engineering, Osaka, Japan, and to the Department of Forestry, Formosa: special thanks were offered also to the firm of the Consolidated Sango Koshi, Ltd., Singapore, and to Mr. Z. TERUYA, Singapore, for assistance in delivering the specimens. The consignment included 19 species, none of which had been grown previously in the Gardens. Some of the species were dwarf-bamboos, others had variegated foliage or black stems. The first consignment was

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planted on the bandstand, the second at the end of the nursery and on the lawn behind the Director's quarters. All were growing vigorously by the end of the year with every prospect of success so that they should supply several horticultural novelties to Malaya. The time will come, moreover, when it will be necessary to revise the study of the wild bamboos of Malaya so that a big collection of such plants in the Botanic Gardens will be a great help to the research-student. At present, the Gardens has more claim to precedence over similar tropical institutions in its collection of palms but there is no reason why the bamboos, aroids, gingers, Cannas and Ixoras should not be added to its vantage.

The meteorological compound was transferred from the lawn near the bandstand to that by the office so that a new lawn was opened for development in 1938.

Potting Yard.—Several adjustments were made in the arrangement of the Potting Yard. Where the big oak-tree had fallen down in 1935, the ground was levelled and on this new area the "trees for sale" were collected. Beside this area a new attap shelter was made to serve as a wood-shed where the labourers could work on rainy days by sawing wood for such various purposes as baskets, stands for climbers and so on. The water-piping between the Yard and the Plant-Houses was renewed over its entire length of some 300 feet.

Propagation.—Experiments were conducted with the synthetic preparation Hortomone A, which has the virtue of stimulating root-growth and, thus, the establishment of cuttings. The solution was made at a strength of a half fluid oz. to one gallon of water. Cuttings were steeped in the solution for 14–18 hours and then planted as usual. Several plants, which had been difficult to propagate by cuttings, were induced to root readily by this means and, with others, the root-growth was so much accelerated that the cuttings were established in a week or two instead of requiring three or four times as long.

Plant-Houses.—A successful new feature was added to the large Plant-House in the form of a frame for succulent-plants, namely Cactus, Aloes, Kalanchœ, Mesembryanthemum, etc. These plants, which are accustomed to the dry climate of rocky and desert regions, do not thrive in the humid, dripping conditions of Singapore or in the hard, ill-drained soil which composes so much of the Gardens. The new frame was therefore designed to simulate the natural environment of "succulents". A glass-roof was built over one of the plant-stands and in place of the stand was substituted a miniature desert with granite and coral-rock resting on a foundation of brick-rubble and consolidated by coarse sand and granite-chippings. A well-drained sunny situation with a loose, dry soil was thus obtained. The numerous succulents, planted in the frame, began to make fresh growth as soon as they were transferred and, apparently, out of nothing but enjoyment of the dryness.

Bandstand Terraces.—A low brick-wall, 80 feet long by 2½ feet high, was thrown across the terrace leading to the former site of the rain-gauge so as to divide the terrace into two lawns. The wall was made of Chinese bricks to match the pergola at one end of the terrace and a herbaceous border was made along the uppermost side of the wall. At the other end of the terrace a large bed was made for flowering shrubs, and, in front of this, the beds of Gerbera were re-arranged.

Useful Ornamental Plants.—The following three plants must be mentioned because of their success in the flower-garden :—

Perennial Phlox, in various colours, was found more suitable than ordinary *Phlox Drummondii* both as a pot-plant and for bedding. It was easily raised from cuttings.

Gladiolas, in various colours, were grown so as to give a continuous flowering at Government House Domain. The bulbs, purchased two years ago, had given by the end of 1937 three lots of flowers. After flowering the bulbs were allowed to develop mature leaves before being lifted. They were dried off in a sand frame and then stored for two months before planting again. Thus the rotation of flowers was maintained.

Lantana Drap d'Or, with golden yellow flowers, was received from Hongkong. It flowered profusely and made a showy pot-plant, though its growth was not strong compared with the common varieties.

Orchids.—More time was devoted to orchid culture than in previous years and a general improvement was made in the condition of most plants. Insect pests, which had always been a trouble, were fairly well controlled by frequent spraying.

The method of cultivation was changed. Whenever possible plants were planted in such a way as to restrict or confine their roots in as small a space as possible, thus offsetting any chance of decay and affording the plants a maximum amount of air. Potting-material for the epiphytic kinds consisted chiefly of a compost made of broken house-bricks (10 parts), charcoal (2 parts) and either tree-fern or Polypodium-fern-fibre (1 part). The size of the particles depended upon the size of the containers used. No manures were used in connection with these plants except by way of a top dressing of well-decayed, clean grass-clippings. Terrestrial kinds were mostly potted into a compost made of burnt soil (10 parts), siftings of the potting-compost used for the epiphytic kinds (5 parts), coarse sand (1 part), leaf-mould (3 parts), peat-moss fibre (1 part), and dry cattle-manure (1 part). Rhodamnia-wood was used almost exclusively as a foundation for the plants grown on blocks.

The hybridising of orchids was continued. The seeds of forty new hybrids were sown in flasks, nineteen of the crosses being made at the Gardens. A survey of the hybrids in cultivation at the Gardens at the end of the year revealed that the collection of these plants, representing 120 epiphytic kinds and 15 terrestrial, numbered about 3,000 plants potted out individually, about 2,000 in seedling-pans and several thousand in various stages of growth in seedling-flasks.

As in the case of the established plants, good progress was made with the seedlings especially those of the Dendrobium-hybrids which had been very backward. Potting-composts were similar to those used with the adult plants except that in most cases they were of a much finer texture, no particles more than one half-inch in diameter being used.

The symbiotic method of raising orchid-seedlings by inoculating them with the root-fungus was tried in the laboratory. A Spathoglottis hybrid (Spath. Primrose × *S. chrysantha*) raised by this method took 17 months to flower.

Three new hybrids raised at the Gardens were flowered for the first time :—

Spathoglottis "Primrose" × Spathoglottis Parsonsii.

Vanda hookeriana × Vanda Miss Joaquim.

Dendrobium undulatum × Dendrobium phalænopsis.

The following Orchids were added to the general collection:—

Renanthera mischootiana, Phalænopsis serpentilingua, Angræcum eburneum, A. sesquipedale, A. articulatum, A. citratum, A. madagascariensis, Grammangis Ellisii, Aeonia madagascariensis, Oncidium triquetrium, O. altissimum, Epipendrum fragrans, E. cochleatum, E. stamfordianum, Cymbidium roseum, Cypripedium Robinsonii, Vanda teres variety *alba, Dendrobium spectabile, D. infundibulum, D. devonianum, D. chrysocrepis* and *Spathoglottis kimballiana.*

Losses.—The most serious loss of the year was the big tree of *Eugenia grandis* by the Dell. It was the finest specimen in the Gardens and was excelled by few others in the island. It was evidently struck by lightning about June though it was not cut down until November in the vain hope that it might recover but, as it lost its leaves and the bark dried, so the Bird's Nest ferns and other epiphytes on its branches withered and fell off. A neighbouring tree of *Artocarpus elasticus* was also killed. Another serious loss was the old Flame of the Forest by the Oleander-bed at the Sundial-terrace: from the abundant brackets which developed on its roots it was clearly killed by that pernicious fungus, *Fomes lignosus.* The one specimen of *Kundangan* (*Bouea macrophylla*) in the Gardens died mysteriously as did a young shapely tree of *Mesua ferrea.* Two old trees of Rhodamnia, one of *Araucaria Bidwillii* and the sole specimen of *Ficus macrophylla* were blown down. An aged tree of Tiup-tiup (*Adinandra dumosa*), which had served well for botanical classes at the office, had to be cut down. The bigger of the two trees of *Artocarpus odoratissima* had also to be removed lest it should infect the other: it had been dying for several years because its bark had been incessantly attacked by beetles and its trunk was becoming riddled by carpenter-bees. The only bush of *Talauma Candollei* died after being transplanted from the bandstand.

Buildings.—A new block of quarters (10 rooms) for the Javanese labourers was built by the Public Works Department. Two old blocks of Javanese quarters and the mosque were demolished. Modern sanitation was fitted by the Public Works Department at the Office, the Director's quarters and the Assistant Director's quarters.

New Planting.—The following species of woody plants, of recent introduction, were planted out during the year:—

TREES

Atalantia spinosa (P. Tioman), *Bauhinia megalandra* (Trinidad), *B. variegata* (Saigon), *Canarium Schweinfurthii* (Kisantu), *Cassia absus* (Dehra Dun), *C. leptophylla* (Rio de Janeiro), *C. Sieberiana* (Rabaul), *C. splendida* (Rio de Janeiro), *C. sp.* (N. Queensland), *Clausena lansium* (Kuala Lumpur), *Cochlospermum hibiscoides* (Hawaii), *Cordia subcordata* (Pangkor), *Cratoxylon pruniflorum* (Burma), *Dillenia ovata* (Raub), *Elaeocarpus littoralis* (Johore), *Flacourtia indica* (Kedah), *F. jangomas* (Kedah), *Gardenia carinata* (Kedah), *Gmelina arborea* (Dehra Dun), *Ilex corallina* (Nanking), *Kleinhovia hospita* (Grik), *Kopsia flavida* (Penang), *Lagerstræmia floribunda* (Penang), *Mangifera cæsia* (Johore), *Myrica Farquhariana* (Formosa), *Ochroma lagopus* (Borneo), *Ochrosia borbonica* (P. Tioman), *Pachylobus edulis* (Kisantu), *Parastemon urophyllum* (Singapore), *Peltophorum dasyrachis* (Malacca), *Sapindus mukorassi* (Singapore), *Spathelia simplex* (Trinidad), *Sterculia alata* (Saigon), *S. carthaginensis* (Trinidad), *Stereospermum fimbriatum* (Malacca), *Zizyphus jujuba* (Perak).

SHRUBS

Calliandra portoricensis (British Honduras), *Callicarpa rubella* (Nanking), *Callistemon lanceolatum* (Uppsala), *Chasalia curviflora* (Kemaman), *Clerodendron* sp. (Kota Bahru), *Dombeya cayensis, D. Mastersii, D. natalensis, D. Wallichii* (Cuba), *Duranta repens* (Formosa), *Gærtnera* sp. (Kemaman), *Hamelia patens* (Bermuda), *Hibiscus costatus* (Singapore), *Ixora Lobbii* (Malacca), *I. multibracteata* (Grik), *I. stenophylla* (Kemaman), *Lantana Drap d'or* (Hongkong), *Melastoma decemfidum* (Kedah), *Nerium* varieties (Penang), *Parkinsonia aculeata* (Aden), *Phaleria Blumei* (Singapore), *Pittosporum tobira* (Italy), *Psychotria* (Kemaman), *Rivinia brasiliensis, R. humilis, R. purpurascens* (Berlin), *Solanum Rantonnetii* (Hongkong), *Sophora tomentosa* (Calcutta), *Strophanthus jackianus* (Penang), *Urena lobata* (Nanking), *Viburnum hanceanum* (Hongkong), *Vitex agnuscastus, V. negundo* (Washington).

CLIMBERS

Aristolochia Bodamæ (France), *A. chapmaniana* (British Honduras), *A. hians* (Buitenzorg), *A. ornithocephala* (Penang), *A. triloba* (Buitenzorg), *Chonemorpha penangensis* (Kuala Lumpur), *Connarus grandis* (Johore), *Manetta coccinea* (British Honduras), *Passiflora serratifolia* (British Honduras), *Thunbergia Kirkii* (Bombay), *Vitis* sp. (Kemaman).

BAMBOOS

Arundinaria graminea (Singapore), *Bambusa dolichoclada, B. stenostachya* (Formosa), *Chimonobambusa marmorea, C. quadrangularis* (Osaka), *Dendrocalamus latiflorus* (Formosa), *Phyllostachys edulis* (Osaka), *P. glauca* (Kuala Lumpur), *P. lithophylla* (Formosa), *P. Makinoi* (Formosa), *P. nigra* (Osaka), *P. pubescens* (Formosa), *P. reticulata* (Osaka), *Pleioblastus gramineus, P. Hindsii* (Osaka), *Pseudosasa japonica* (Osaka), *Saccharum senanensis* (Osaka), *Sasa chartacea* (Osaka), *Semiarundinaria senanensis* (Osaka), *Shibatæa Kumasasa* (Osaka).

MISCELLANEOUS

Areca triandra var. *borneana* (Buitenzorg), *Iguanura* spp. (Kemaman), *Pandanus* spp. (Johore), *Pinanga riparia* (Johore), Zingiberaceæ (various Malayan species of Alpinia, Amomum, Bœsenbergia, Globba, Hornstædtia, Phaeomeria, Zingiber collected locally by Mr. CORNER).

WATERFALL GARDENS, PENANG

The usual routine and maintenance work was carried on as in former years.

Some attention was given to the orchid collection, and the greater part was repotted in accordance with methods found satisfactory in Singapore. Various methods of dealing with *Phalænopsis* spp. were tried. So far the most successful appears to be that in which the plant is grown on the outside of a piece of coconut husk.

Experiments with Hortomone A, samples of which were received from the Imperial Chemical Industries, Ltd., were tried on cuttings of plants normally difficult to propagate. The experiments indicated that little difficulty should be experienced in rooting cuttings of such plants as *Dipladenia, Bougainvillea formosa* and so forth.

Experiments in the control of slugs and snails by means of powdered Meta-fuel mixed with rice-bran proved successful.

Attempts were made to graft a brilliantly coloured but straggling *Bougainvillea,* such as *Mrs. Butt,* on to a more compact stock. One inarch and one cleft-graft were successful. Probably the inarch-method is the one most likely to give quick results.

A considerable time was spent on the card-catalogue of new introductions, chiefly in bringing it up to date. Also, a start was made with the re-numbering and cataloguing of permanent trees and shrubs in the Gardens, and at the end of the year some 400 trees and shrubs on Lawn A, Lawn B, Lawn C, Lawn E and Lawn S had been dealt with. Many of these trees and shrubs had been numbered in 1922, but the labels used were small and fragile and soon became illegible or were lost. The new numbers, which were punched out of heavy sheet zinc, should prove much more durable.

The most important piece of work during the year was the completion of the New Garden in Lawn V. The pavilion was finished early in the year by the addition of the roof and the laying of old Malacca flooring tiles. The terrace was paved with concrete slabs and the surrounding walls finished off with concrete capping tiles. The three sets of steps leading up to the terrace were laid with old Malacca tiles. Crazy paving was made and laid in the fore-court and planted with such low growing plants as *Zinnia linearis, Hymenatherum tenuilobum, Portulaca, Verbena,* etc. The climbers on the pergola were planted and made very rapid growth. A double row of *Gnetum gnemon* (28 in all) was planted on each side of the long borders, and these borders, each measuring approximately 250 ft. × 10 ft., were completely planted up, there being some 73 separate plantings in each of the four sections. The lily tank in the centre of the garden was filled with water and the wings at each end filled with soil, in which it was intended to grow *Nelumbium. Cyperus papyrus* was planted and grew vigorously, but neither *Nelumbium* nor *Nymphæa* could be induced to grow, even after many attempts. This difficulty had been encountered before in brick and concrete tanks, and it might be due to some toxic substance, to which water lilies are extremely susceptible, being leached out of the walls. The water-supply was derived from the pond in the Lily Gully and was used in the tank in the Formal Garden, in which waterlilies grew quite well. The acidity of the water, which was remarkably low, was the same in both tanks.

The most troublesome part of the work in the New Garden was the erecting of the pillars on the outside of the borders. These were intended to support creepers and were of reinforced concrete, T -shaped, alternately round and square in section and linked by double chains. They were cast *in situ* and great pains were taken to ensure that they were properly alligned. Some difficulty was encountered in adjusting the height of the pillars due to the fact that the ground was not level. The whole of the work on the New Garden was done by the Gardens staff, an extra mason only being employed until March. There is little doubt that this new garden, when the plants are fully grown, will be an asset to Penang. It is something quite new in gardening in this part of the world.

The mowing gang, early in the year, was deprived of its favourite implement—a section of an old scythe blade inserted in a wooden handle. This killed more grass than it cut, resulting in the continued bareness of steep slopes. It also caused injury to exposed tree roots. On slopes where mowers could not be used, garden shears proved satisfactory, if they were kept sharp, and after the coolies had got used to them. The general effect of the abolition of the "Kai Kutti" was that the slopes looked rather more untidy than formerly, but it was better to have these slopes well covered with grass than practically denuded.

Masonry.—The curb-work on the roadsides was resumed towards the end of the year. Repairs were made to the stream banks in the Fern Rockery.

Buildings.—The Gardens Office was extensively overhauled and re-roofed by the Public Works Department and a new room built on. The Public Works Department also carried out the following:—

> The Tool-shed in the nursery was overhauled and re-roofed with asbestos. The seed-propagating-house in the nursery was re-roofed with wired glass. Plant houses Nos. 3, 5, 6 and 10 were repaired. Small repairs were done to the roads.

Flowering of Bambusa Blumeana.—All the clumps of this bamboo in the Gardens and Residency grounds, except one by the Middle Bridge in the Gardens, began to flower about the beginning of the year. Unfortunately no record could be traced of when they were planted, but as far as could be ascertained it was more than 30 years ago, and this was their first flowering. Presumably all were planted about the same time except for the clump mentioned above.

At the beginning of the year flowering was heavy all over the clumps, those in the Gardens flowering more profusely than the others. The culms flowered in a leafless state and, after flowering, died. Spasmodic flushes of flower occurred at intervals and, at the end of the year, some culms were still flowering. The flowers were visited by large numbers of insects, particularly the bees *Melipona* sp. and *Apis indica*.

The clumps in the Gardens showed no sign of new growth during or after flowering and at the end of the year, appeared dead or dying. Those in the Residency continued to produce a few new culms, but they also flowered, and although at the end of the year most clumps showed a number of leafy stems, it seemed probable that all would die down eventually and have to be removed.

Planting.—As in 1936, such concentration of work as the development of the New Garden in Lawn V did not allow of much more than routine maintenance in the upper part of the Gardens but the following planting was done:—

Lily Pond Gully: *Clerodendron Bakeri, Scyphostegia borneensis Couroupita guianensis*, and a large number of local trees to fill gaps.

Lawn S: *Gœthia strictifolia, Pereskia grandiflora, Tabebuia rosea, Erythrochiton brasiliense.*

Lawn O: *Bauhinia monandra, B. variegata, B. candida, Cassia biflora, C. fruticosa.*

Lawn J: *Paranephelium macrophyllum.*

Lawn L: *Terminalia belerica, Eugenia xanthocarpa, E. pitanga, Parmentiera cerifera.*

Lawn E: *Saraca bijuga.*

Lawn N: *Couroupita guianensis.*

Fern Rockery: *Saraca taipingensis.*

Losses.—No trees of any value were lost during the year. Owing to the office extension some trees of *Crypteronia paniculata* and *Grewia paniculata* had to be removed from the bank behind the office.

A large plant of *Vanda Batemanni* was stolen from the Orchid Garden and there were one or two other small thefts, which will be inevitable if the Gardens are open to the public at night.

GOVERNMENT HOUSE DOMAIN AND OTHER OUTSIDE CHARGES

Singapore

The grounds of the Domain were maintained in good order and several improvements were made by the additional planting of trees and shrubs, the reconstruction and reconditioning of shrubberies and the renewing of grass verges in several sections near the house.

The chief undertakings were the regrading and terracing of the Congea-shrubbery; the removal of two groups of *Ptychosperma McArthuri*-palms and their replacement with two groups of Bougainvillea, Mrs. Butt and Mrs. McLean, on either side of the pathway leading to the hard tennis court; the planting of a row of *Hibiscus mutabilis* with a background of *Jacaranda filicifolia*, at the side of the driveway leading behind the house; the planting of several *Mesua ferrea* and one *Pterocarpus indicus*, "Angsana", near the Guard-Room; the enlarging of the *Dacrydium elatum*-planting by the addition of seven plants; the planting of twenty-four Jacaranda and *Acacia auriculæformis* on either side of the drive leading to the garages; and the planting of *Poinciana regia*, *Albizzia moluccana*, *Eugenia caryophyllata*, "Cloves", and *Arfeuillea arborescens*, "Hop tree", at other vantage places.

The routine-work of replanting flower-beds and borders, when the occasion demanded, was well carried out and a bright show of flowers was obtained throughout the year. The maintenance of the lawns presented some difficulties. A large section in front of the house had to be turfed again and several verges behind the house had to be renewed. The motor-mowers, which have been in constant use for several years, showed signs of wear and had to be overhauled on several occasions, at which times the work had to be done by hand-machines.

Several trees had to be cut down on account of their being considered dangerous. Of these the most noteworthy were a large *Ficus benjamina* near the nursery, a tree of *Caryocar nuciferum*, "Butter nut", from near the hard tennis court, several *Poinciana regia* and four *Spathodea campanulata*. No replacement was made except in the case of the Poinciana.

The tennis-courts on the lower terrace in front of the House were entirely relaid. The work was placed in the hands of Mr. D. H. Kleinman. Assistance with the work was given by the removal of a greater part of the old turf and some of the soil. At the completion of Mr Kleinman's contract, the courts were hand-weeded on two occasions and given other necessary attention.

An additional area of the enclosed nursery was given over to the growing of plants suitable as cut flowers. New beds of Vanda Miss Joaquim Cladiolus and *Polianthes tuberosa*, "Tuber-rose", were added. The orchid, *Renanthera coccinea*, was newly added.

The pot-plant section was maintained as formerly. The following plants were additionally grown for purpose of house decoration :—Kochia, perennial Phlox, *Tecomaria capensis* and several new varieties of Dahlias.

A large number of pot-plants were used for decoration within the house; the majority were flowering plants and had to be renewed at frequent intervals. The tubs of palms, used for decorating the alcoves on the lower verandah, were dispensed with as window boxes were made for each archway. An additional hundred plants were required to fill the window boxes.

At the Colonial Secretary's house the grounds were maintained as usual. No new planting was undertaken but the major portion of existing shrubberies and flower beds was kept well cultivated and bright with flowers. The palms in wooden tubs on the lower verandah were transferred into concrete pots. Two large trees of "Tembusu" and *Araucaria excelsa* were cut down and removed. The Araucaria was partly blown down in a storm and damaged a part of the garage in its fall. During the dry period in August, the hard tennis-courts had to be watered copiously to prevent them from crumbling.

Municipality.—The routine of inspection and advice was maintained as in former years: weekly inspections of the roadside-trees were made and weekly reports submitted. Eight hundred trees were planted and 200 replacements were made. A special consideration was the planting of new kinds of tree which should be suitable for ornament or shade on the roadsides, and the following were tried out for the first time in Singapore:—*Acacia auriculæformis, Bauhinia monandra, Cassia multijuga, C. nodosa, Dillenia ovata, Gardenia carinata, Stereospermum fimbriatum.*

Horticultural supervision was given to the planting of ornamental trees and shrubs in the Municipal Parks. At Farrer Park, the area about the playing ground and the tennis-courts was laid out with shade-trees, flowering shrubs and decorative palms. At Jubilee Park, quick-growing trees were spaced out upon the hillside as the basis of a bigger programme. At Katong Park the re-arrangement of the shrubberies and the greater part of the planting was completed.

PENANG

Residency Garden.—No changes were made in the garden, but there was considerable improvement in the standard of the flowering pot-plants.

Hill Gardens.—No important alterations were made to these gardens. A new Bougainvillea-hedge was planted at the entrance to the Crag Hotel and some of the slopes near the entrance were re-turfed with finer grass. The plantation of *Pinus Merkusii*, on the slope between "Convalescent" and "Fernhill", made good progress: the coarse grass and ferns were kept slashed and the pines themselves grew vigorously. The supply of vegetables from the vegetable-garden was uncertain and dependant, as usual, on the weather: high wind and rain did much damage.

Municipality.—Reports on roadside-trees and gardens were made where necessary and advice was given.

Other Work.—Advice on planting was given to various clubs and private residents. For Poppy Day, the wreath-frames were prepared as in previous years.

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STRAITS SETTLEMENTS

ANNUAL REPORT

OF THE

DIRECTOR OF GARDENS

FOR THE YEAR

1938

BY

R. E. HOLTTUM, M.A., F.L.S.,
Director of Gardens, S.S.

Published by Authority

SINGAPORE:
Printed at the Government Printing Office, Singapore,
by V. C. G. Gatrell, Acting Government Printer.

1939

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ANNUAL REPORT OF THE GARDENS DEPARTMENT, STRAITS SETTLEMENTS, FOR THE YEAR 1938

STAFF

Mr. E. J. H. Corner, Assistant Director, acted as Director during Mr. Holttum's absence on leave, until 18th June; Mr. Corner himself took leave from 16th July and was away for the rest of the year. Mr. M. R. Henderson, Curator of the Herbarium, who had been taking charge of the work of the Department at Penang since February, 1937, returned to his normal duties in Singapore on 18th July, 1938, when Mr. J. W. Ewart, Assistant Curator, took charge at Penang. Mr. G. H. Addison was appointed to the vacancy caused by Mr. Flippance's transfer to Hong Kong. Mr. Addison arrived in Singapore on 4th June, and took over the duties of Assistant Curator, Parks, from Mr. J. C. Nauen, who then took charge of work in the Botanic Gardens, Singapore, until his departure on leave on 18th November.

Sappi bin Hassan, Foreman Gardener, retired on 22nd April, and was replaced by Sappan bin Hassan, whose place as junior foreman was taken by Marzuki bin Abdul. The additional post of Plant Collector caused by the appointment of Ngadiman bin Haji Ismail to take charge of the botanical reserves was filled by Hassan bin Mohamed Rani, senior label printer.

LABOUR

The labour forces remained approximately as in 1937, namely 85 at the Botanic Gardens, Singapore, 57 at Government House Domain, and 50 at the Waterfall Gardens, Penang. In addition, temporary labour was engaged for special work in Government House Domain, as reported below. The minimum wage remained at 50 cents. The health of the staff continued to be satisfactory.

REVENUE

The revenue from the sale of plants, seeds, etc. was as follows :—

	$	c.
Singapore:—		
Sale of plants and seeds	2,392	78
Inspection fees, etc.	551	53
Municipal contribution for Assistant Curator's services	2,400	00
Penang:—		
Sale of plants and seeds	511	80
Municipal contribution for Assistant Curator's services	1,200	00

PLANT COLLECTIONS AND FIELD EXCURSIONS

Owing to leave and changes of staff, less botanical field work was possible in 1938 than has been usual in recent years. The need of such work, as explained fully in the report for 1937, does not decrease, but rather the reverse. When senior officers are not available, it is often possible to send out trained Malay collectors, who have made very useful collections. In this matter, co-operation with the Forest Botanist at Kepong has continued, to the mutual advantage of both institutions.

Mr. E. J. H. CORNER paid a number of visits to the neighbouring parts of Johore during the early part of the year, continuing his field work on this very interesting area. He also collected regularly in the Bukit Timah reserve (*see below*).

In April and May the Plant Collector Kiah bin Haji Salleh went to Kedah and Perlis, where he made extensive collections, especially on the limestone at Kaki Bukit, Perlis. Here he found an interesting new species of the genus Buxus, related to *Buxus Rolfei* of the Philippines. This is the third relative of the northern box tree (*Buxus sempervirens*) to be found in Malaya; all are limestone plants.

The primary object of Kiah's visit to Perlis was the collection of seeds of wild bananas, to be sent to the West Indies, where seed-bearing species are needed in breeding experiments. The object of these experiments is to produce new varieties of edible bananas resistant to disease. Kiah's search unfortunately failed to produce any species beyond those already known further south, but seeds were sent to Kew and the West Indies in the hope that they might prove useful.

In May Mr. HENDERSON paid short visits from Penang to the limestone hills at Baling and Alor Star in Kedah, and to the Sungei Krian at Selama on the Kedah-Perak boundary. Near the summit of Gunong Baling an abundant growth of a grass resembling lemon-oil grass was found. Mr. C. E. HUBBARD of Kew reports that this appears to be a new species. Plants of it have been obtained for cultivation in Singapore.

In July and August two collectors were sent to Sarawak, in company with a Sakai tree climber from the Forest Department, F.M.S. These three men made useful collections, chiefly of trees. The necessary local arrangements were kindly made by the Senior Forest Officer, Sarawak, who is to receive a set of the specimens collected. The flora of Sarawak is closely related to that of the south of Malaya, and it is very valuable to have such collections for comparative purposes.

In October, Kiah bin Haji Salleh again visited Kedah to collect specimens in an area of forest which was being felled near Sungei Patani. Thanks are expressed to Dr. E. D. B. WOLFE, Health Officer, Sungei Patani, in connection with this visit, especially for pointing out a very interesting species of Petraeovitex which is probably new. It is also a very handsome species and will probably prove a striking addition to local gardens; cuttings have already been rooted in the Waterfall Gardens.

Within Singapore Island collections were also made of many common local and cultivated plants, as these have often been neglected by collectors, and are not always well represented in herbaria. Considerable series of duplicates of these collections were made for distribution.

BOTANICAL RESERVES

As already reported, the former Bukit Timah Forest Reserve was taken over by the Gardens Department in July, 1937. Timber thefts in 1938 were few, showing that the regular patrols are effective, and the areas formerly devastated by illicit felling are for the most part growing up satisfactorily into new thickets. Some of the older open areas are much overgrown with Gleichenia fern (Rĕsam); it is intended to deal with these gradually as labour is available, to cut back the fern and when necessary to plant new local trees.

A new path was made skirting the head of the fern valley, and another near the eastern boundary of the reserve; this latter path, by permission of the Municipal Water Engineer, was continued through the adjacent part of the water catchment area to the Dairy Farm. These paths open up to convenient access parts of the forest formerly not easily accessible. They make the duty of patrolling easier and have also provided very pleasant new walks within the forest.

The Health Department constructed an artificial pool in one of the valleys on the western side of the reserve. This pool serves as a reservoir for flushing the exposed lower part of the valley for anti-malarial purposes; it also provides a delightful forest pool which will serve an interesting purpose for the culture of shade loving water plants and native fish.

The regular collecting of tree specimens in the reserve, with the aid of the botanical monkeys (*see* 1937 report) has continued. Specimens are brought in almost every day, and as a result a number of additional trees have been labelled, adding both to the botanical value of the reserve and to its interest for visitors. These collections have been of particular interest and value to Mr. HENDERSON in his work on the genus Eugenia. At least 30 different species of this genus have been found in the reserve, and ample material both of flowers and fruit has been available for investigation. Two of the species found during the year had not previously been known to exist in the southern part of Malaya.

In addition to the collection of specimens, seeds of many interesting local trees have also been collected in the Reserve. Some of these seeds have been sown for re-afforestation or other local planting; others have been sent to botanical institutions in other parts of the world.

In addition to the Bukit Timah Reserve, two other areas in Singapore have been selected for preservation. These are areas of Mangrove, one at the 14th mile on the road to Johore, the other by the Pandan and Jurong rivers. The old trees in these areas have mostly been felled but there is much young growth which if left will adequately preserve the character of the mangrove. It is most desirable to retain within easy access of the town samples of this very interesting vegetation, with the characteristic features of which all local students of plant life should be acquainted. The area near Kranji is not regularly patrolled at present, and it is difficult to prevent thefts of small timber. The Pandan area, which is much larger, is patrolled by a Chinese charcoal burner, who is allowed to cut timber under strict supervision.

The boundaries of the above three reserves were agreed upon and surveyed during the year, but the final arrangements for constitution as Forest Reserves were not completed. They are to be made Forest Reserves for convenience of administration, not because they will be exploitable as forests. The Director of Gardens has been gazetted a Conservator of Forests in order to have control over them.

HERBARIUM WORK AND OTHER INVESTIGATIONS

Until Mr. HENDERSON'S return in July, the routine work of the herbarium was carried out by Mr. C. X. FURTADO, Assistant Botanist. A number of determinations were made for the Department of Agriculture, especially of grasses and weeds, and for the Rubber Research Institute. Mr. FURTADO spent much time in entering references on the sheets bearing duplicate types of new species described during the year, including the palms from New Guinea collected by the late Mr. C. E. CARR and named by Prof. M. BURRET.

Mr. HENDERSON worked over an interesting collection made by Mr. GORDON SPARE on the tidal banks of the Krian river at Bagan Serai, and also made preliminary identifications of a large number of specimens sent by the Conservator of Forests, British North Borneo. Mr. HENDERSON spent most of the rest of his time continuing his work on the large genus Eugenia, represented in Malaya by about 140 species. In connection with this work, much valuable material has been lent from the herbaria at Leiden, Buitenzorg, Calcutta and Dehra Dun, including the types of many species. The loan of these specimens has been of great assistance to Mr. HENDERSON, and thanks are expressed to the Directors of the herbaria in question. Mr. HENDERSON has also investigated the structure of the seeds of as many species as possible of Eugenia, as information on this subject is very incomplete and variations of structure appear to be of diagnostic importance.

Mr. FURTADO continued and extended the work on the genus Homalomena (Araceæ) mentioned last year. For this purpose almost all the specimens of the genus in the Buitenzorg herbarium were obtained on loan, and assistance was also obtained from Kew and Leiden. A paper embodying the results of the whole investigation was prepared and made ready for publication in the Gardens Bulletin. Mr. FURTADO also continued his work on palms, of which about 300 specimens were mounted on the new large-size sheets, identified, and laid into the new cabinets obtained during the year.

Until his departure on leave, Mr. CORNER continued his work in connection with the preparation of his book on the common trees of Malaya. He embodied the results of the necessary preliminary critical studies in a series of papers on the systematy and distribution of Malayan phanerogams, for publication in the Gardens Bulletin. The first group of these papers were almost ready for issue by the end of the year, and also Mr. CORNER'S paper on the subgenus Synœcia of the genus Ficus.

During his leave in Europe, the Director spent nearly two months working in the herbaria at Kew, the British Museum, Cambridge and Paris. He undertook a wider study of the group of acrostichoid ferns which he has investigated in Malaya, examining specimens of the genus Lomariopsis from all tropical regions. In this he was greatly assisted by the loan of material from Washington, New York, Berlin and Brussels. He also spent some time making critical notes on other groups of ferns, and followed up an investigation of the genus Bougainvillea which was started by Mr. F. FLIPPANCE. An attempt was made to trace all references to cultivated Bougainvilleas, with the object of stabilizing the nomenclature of the varieties cultivated in Malaya. It is clear that the names of Bougainvilleas differ somewhat in different parts of the world; *e.g.* the variety known in Malaya as "Mrs. BUTT" is called "Crimson Lake" in Florida, but a variety introduced to Malaya as "Crimson Lake" proves to be something quite different. The difficulty of establishing the meaning of names is increased by the fact that various shades of colour of different varieties cannot be described accurately in words; and without coloured illustrations or reference to colour standards, descriptions of Bougainvilleas are often of little value. This investigation has led to correspondence with several botanists and botanical institutions in other parts of the world, who have helped by sending specimens and descriptions of Bougainvilleas cultivated in their respective countries. It seems probable that the well known "Mrs. Butt" (often wrongly regarded as a variety of *B. spectabilis*) is a distinct and undescribed species.

Duplicate herbarium specimens were distributed as follows during the year:—

The Herbarium, Buitenzorg, Java	659
Royal Botanic Gardens, Kew	545
Botanic Gardens, Berlin	439
British Museum, Natural History	386
Prof. Bartlett, Michigan, U.S.A.	306
Dr. E. D. Merrill, Arnold Arboreutm, U.S.A.	306
Royal Botanic Gardens, Calcutta	275
Forest Research Institute, F.M.S.	267
Bureau of Science, Manila	240
Rijks Herbarium, Leiden, Holland	159
Botanical Survey, Pretoria, S. Africa	136
Dr. A. F. G. Kerr, England	28
Total	3,746

The following material was sent on loan for study by botanists preparing monographs or for other special purposes:—

Dr. Danser, Groningen, Holland (various families)	248
Dr. H. J. Lam, Leiden, Holland (*Convolvulaceæ* etc.)	233
Dr. van Steenis, Buitenzorg, Java (various families)	93
Dr. Kükenthal, Germany (*Cyperaceæ*)	73
Dr. A. F. G. Kerr (Siamese plants)	24
Mr. Hatshushima, Japan (*Buxus*)	16
Forest Research Institute, F.M.S. (*Dipterocarpaceæ* etc.)	12
G. H. Spare, Perak (*Melastoma*)	8
C. E. Hubbard, Kew (*Cymbopogon*)	2
Total	709

The following duplicate specimens were received in exchange by the Singapore Herbarium:—

Dr. E. D. Merrill, Arnold Arboretum, U.S.A.	2,057
Lingnan University, Canton	1,035
Museum d'Histoire Naturelle, Paris	283
Conservator of Forests, B.N.B. (Bornean plants)	236
Harvard University, U.S.A. (*Orchidaceæ*)	210
Bureau of Science, Manila	90
Economic Botanist, Mandalay, Burma (grasses)	75
Government Botanist, Brisbane, Australia (ferns)	65
Royal Botanic Gardens, Kew (Bornean plants)	43
Total	4,094

LIBRARY

Two more glass-fronted library cases were obtained during the year, one accommodating the valuable complete series of the Botanical Register and the Botanical Magazine, and the other the majority of the remaining larger books. Most of the more valuable books are now housed in glass cases. Opportunity was again taken to purchase several older works relating to Asiatic botany, hitherto not represented in the library. Mr. FURTADO has continued the routine library work as in former years, including the indexing of literature relating to Malaysian plants. The number of periodicals now received in the library is 140.

PUBLICATIONS

Volume IX, Part 4, of the *Gardens Bulletin* was published in March; it contained a further instalment of Mr. C. F. SYMINGTON'S critical work on the Dipterocarpaceæ, and a paper by Mr. R. E. HOLTTUM on the genus Teratophyllum, completing his work on the Malaysian climbing ferns of this group.

Volume X, Part 1, of the *Gardens Bulletin,* comprising 182 pages, was almost ready for issue at the end of the year. It contained two papers by Mr. E. J. H. CORNER embodying some of the preliminary studies made in connection with the preparation of a book on the common trees of Malaya, an account of the group of climbing figs of the subgenus Synœcia, and two papers on nomenclature by Mr. C. X. FURTADO. Mr. FURTADO also published five short papers on nomenclature in *Chronica Botanica* and Fedde's *Repertorium.*

Articles on local horticulture were contributed by the Director and other members of the staff to the *M.A.H.A. Magazine,* as in previous years. The Director also contributed an article on Bougainvilleas to the *Gardeners' Chronicle* (London).

PLANTS OUTWARDS AND INWARDS

SINGAPORE :—

Outwards:—

Plants sold	7,505
Tubers, cuttings, etc. sold	8,004
Seeds sold	480 packets
Plants etc. sent on exchange	1,746
Plants etc. supplied free	3,476
Seeds sent to other Botanical Institutes ...	181 packets

Inwards:—

Plants collected by staff	148
Seeds collected by staff	35 packets
Plants received as gifts or exchange ...	399
Seeds received as gifts or exchange ...	16 packets
Plants and bulbs purchased	1,236
Seeds purchased	250 packets

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PENANG :—

Outwards:—	
Plants	4,178
Cuttings, etc.	7,063
Seeds	46 packets
Inwards:—	
Plants	593
Seeds	348 packets
Cuttings, etc.	171

The gift of seeds and plants from the following persons is gratefully acknowledged :—Sir HARRY MOXHAM, Madame THAVARA JAIYANTA, Mr. F. KINGDON WARD, Mr. E. GALISTAN, Mrs. W. I. L. LEGG, Capt. A. T. A. RITCHIE, Mr. W. N. C. STEELE, Prof. N. G. BALL (Colombo), Dr. A. REID, Mr. E. D. BUTLER, Mr. Z. TERUYA, Mr. O. F. RICKETTS, Mr. E. W. MOLESWORTH, Mr. G. E. C. WATSON, Mr. J. N. MILSUM, Mr. J. W. HOPE. Sir HARRY MOXHAM presented 14 varieties of oleander. Captain RITCHIE'S gift was a collection of orchid plants which he had himself collected in Malaya. Mr. RICKETTS presented a plant of *Rhododendron Brookeanum* and Mr. E. D. BUTLER one of *Rhododendron longiflorum;* further notes on these plants are given under Botanic Gardens, Singapore, below.

Seeds or plants were received on an exchange basis from the Botanic Gardens at Kew, Rio de Janeira, Delft, Tokyo, Stockholm, Lyon, Edinburgh, St. Andrews, Rostock, Berlin, Uppsala, Cambridge, Kristenbosch (Cape), La Mortola, Hong Kong, Malta, New York, Chicago, Buitenzorg, Peradeniya, Calcutta, Saigon, Montevideo; and from the U.S. Department of Agriculture, The East African Research Station (Amani), Department of Forestry, Taihoku, Coconut Grove Arboretum (Florida), Atkins Institute of the Arnold Arboretum (Cuba), The Royal Agri-Horticultural Society of India, Mt. Elgon Nurseries (Kenya), The Chandra Nursery (Sikkim), Bangkrabue Nursery (Bangkok), Mr. W. R. HOLLOWAY (New Zealand).

THE BOTANIC GARDENS, SINGAPORE

Routine work continued in the Gardens as usual, the only change in general practice being the regular use of rock phosphate whenever new holes were made for planting, or when young trees were dug and manured. In planting new trees, it has been found that a compost of decaying leaves and grass cuttings with rock phosphate, thoroughly mixed with the ordinary garden soil, has given good results without the addition of any other manure. The same mixture has been used when young trees were in need of further cultivation.

The only important change in the Gardens during the year was at the outflow of the lake. The culverts carrying the outflow water beneath the path were frequently choked with the roots of the large *Ficus Kurzii* near by. The path was opened, and a small bridge constructed over the outflow; below the bridge the banks of the stream were made up with coral, and planted with ornamental plants.

Bougainvilleas.—As above noted, the Director spent some time at Kew in an attempt to trace the origins of the various cultivated Bougainvilleas, which have increased in number and variety so remarkably in recent years. It is hoped that this will lead eventually to a stabilizing of the names of these plants, but several of them are still in doubt. Meanwhile the collection of varieties in cultivation at Singapore increases steadily, and in August, 1938, sixteen distinct varieties were simultaneously in flower. The Director brought from Kew two plants different in name from those already in Singapore; on flowering, they proved, however, to differ in name only. The Director also purchased a new variety, "Lady Hudson"; this proved to be quite distinct, and is apparently the same as the Bougainvillea known as "Ecuador Pink" in Trinidad. This is probably its first introduction to Asia; it is too early to say how well it will flower locally. Other new Bougainvilleas were imported from Peradeniya and Calcutta, the latter being a selection of hybrids raised by Mr. S. PERCY-LANCASTER in the Gardens of the Royal Agri-Horticultural Society of India. It is too early also to say how well these new forms will behave locally.

Broadly speaking, the varieties of *B. glabra* (all of them more or less bright purple) are perpetual-flowering in Singapore. The varieties of *B. spectabilis* (including the brick-red *lateritia*) need a good deal of dry weather to flower well; they rarely flower freely here, and are green most of the time. The third group, consisting of Mrs. BUTT, Mrs. McLEAN and LOUIS WATHEN, are seasonal in flowering when planted out (though flowering more readily than *spectabilis*), but have the great advantage that they can easily be made to flower in pots. The new hybrids are mostly between varieties of *B. spectabilis* and *B. glabra;* they all partake in some degree of the seasonal character of the former, but it seems likely that some of them will flower well enough to be worth general planting here. What is now required is to bring the Mrs. BUTT group into the scheme of hybridization. We have always thought that Bougainvilleas would not set seed in Singapore; but the reason is perhaps only because they are self-sterile, and it is quite possible that artificial cross-pollination may yield seeds.

Lantanas.—During the past few years several free-flowering varieties of Lantana have been collected from various sources, and have proved extremely useful, both in beds and in pots. They grow very easily, flower continuously, and are very little trouble except for the attacks of certain scale insects. In 1938 a notable addition was made to the collection of Lantanas by the introduction from California of a packet of seeds of dwarf hybrids, several of which have proved distinctive. We now have a considerable range of colours from white to pink, mauve, yellow, orange and scarlet, some of them showing interesting colour changes from young to old flowers on the same head.

New Herbaceous plants.—For two or three years past a yellow Composite has been grown in Singapore, introduced from Malacca; through the courtesy of the Director of the Royal Gardens, Kew, it has now been identified as *Melampodium divaricatum,* native in Central America. Its introduction to Malaya is a mystery, as it does not seem to be in general cultivation in any other part of the eastern tropics. Though not strikingly beautiful, this Melampodium is very useful and hardy under local conditions. The other new annual which has appeared during the year is a strain of *Browallia elata* of an exceptionally good blue, which is also exceptionally free-flowering in Singapore. This also seeds freely here.

Cassias. Cassis spectabilis, a yellow-flowered tree introduced from Buitenzorg in 1935, has grown and flowered well, and has also borne numerous fruits. Though it may prove somewhat lax in habit, it is certainly worth growing for its large and handsome bunches of flowers. *Cassia splendida,* introduced from Rio de Janeiro, proves to be the largest-flowered of all our shrubby Cassias, and of a good deep yellow.

Conifers.—One of the plants of *Pinus Merkusii*, planted at the end of 1935, had reached a height of about 12 feet by the end of 1938 and was still in vigorous growth. This is larger than any true pine which has ever been grown previously in Singapore. A neighbouring Cassia tree, which caused the pine to grow one-sidedly, was cut down, and the pine responded immediately. It clearly needs a fully exposed position. Other interesting conifers which have made a good start are *Podocarpus usambarensis* (E. Africa), *Callitris intratropica* (N. Australia), and *Fokienia Hodginsii* (S. China).

Rhododendrons:—As above noted, Mr. E. D. BUTLER presented a plant of *Rhododendron longiflorum* (a Malayan species which grows on trees or on rocks at moderate elevations) and Mr. O. F. RICKETTS of Kuching presented a plant of the Bornean *R. Brookeanum*. Both these were grown in pots, and flowered. Both are beautiful species and well worth growing in Singapore for their flowers, but they evidently need some care in cultivation. In view of the great amount of hybridization which has been carried out with Rhododendrons in other parts of the world, it is certainly worth while to try this also in Singapore. Experiments were, therefore, tried towards the end of the year, and seedlings germinated. A technique for raising these tiny plants needs to be perfected. Crosses will be attempted between the local species and the few Azaleas which grow well in Singapore.

Orchids.—The orchid collection continued to do well under Mr. NAUEN'S management, and in the latter half of the year a number of the hybrid seedlings flowered for the first time. The most spectacular of these were the Dendrobiums. A number of plants of *D. phalænopsis* × *undulatum* ("Pauline") flowered freely, and for several months there were always a group of these on show in the plant house. *D. phalænopsis* × *superbiens* proved much less vigorous, but a few plants flowered, of a very handsome deep purple colour; this group is distinctly variable in the form of the flower. Smaller, but very dainty, and also lasting in good condition for more than a month, were *D. bigibbum* × *veratrifolium* of which we have a good batch of plants raised from seeds provided by Mr. MUNGO PARK. These seem slower in growth than "Pauline" but the plants are quite vigorous.

Three new Vanda hybrids flowered during the year. *Vanda sumatrana* × Miss JOAQUIM (seeds from Mr. J. LAYCOCK) is attractive, and also fragrant; but, like all seedlings of Miss JOAQUIM, it is variable, and so far the smaller flowered plants have proved most free-flowering. Several seedlings of Vanda Miss JOAQUIM × *Hookeriana* flowered, no two alike. The best of them are quite distinctive and attractive; others are very near *Vanda Cooperi*. Equally variable were the seedlings of *Vanda Cooperi* × Marguerite Maron; most of them seem to have a lip of bad shape, or poor colouring, but it is still possible that a good form may appear.

Within the genus Arachnis, we had hitherto only produced *A. flos-æris* × *Hookeriana*, which proved to be almost identical with the wild *A. Maingayi*. Seedlings of *A. Maingayi* × *Hookeriana* flowered during 1938, and were as variable as the Vanda hybrids mentioned above. The best of them is an attractive addition to the group of scorpion orchids and is quite free-flowering.

Two hybrids between the genera Vanda and Arachnis (for which the "generic" term Aranda is used) also flowered during the year. The larger of these was *A. Hookerianan* × *V. Dearei;* it had yellow flowers, very fragrant like its Vanda parent, of good size and appearance but on rather a short stalk. *A. Hookeriana* × *V. lamellata* had smaller flowers, but on longer stalks; it has much the habit of a scorpion orchid, but is quite distinctive and will probably be a useful plant for general cultivation later.

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Spathoglottis hybrids raised during the year were rather disappointing, and few in number, as the hybrids of this genus seem to be almost sterile. The best hybrids are still the orginal "Primrose" (*S. plicata* × *aurea*) and "Parsons Junior" (*Parsonsii* × *plicata*). We have now succeeded in obtaining a fair quantity of seeds from the latter by selfing and hope for some interesting results.

Of new additions to the general collection, the most important were *Dendrobium trilamellatum, D. stratiotes, D. d'Albertisii, D. leporinum, D. Johannis* and *D. pseudoconanthum*.

New Planting.—The following new plants of recent introduction were planted out during the year :—

TREES

Artocarpus integrifolia var. silvestris,
Acacia Hindsii,
Acacia Berlandieri,
Casuarina distyla,
Casuarina torulosa,
Calpurnia aurea,
Cupressus Benthamii,
Cupressus cashmeriana,
Cassia excelsa var. augustifolia,
Durian Au,
Gmelina arborea,
Juniperus bermudiana,
Kopsia flavida,
Ochrosia borbonica,
Podocarpus Rumphii,
Pinus massoniana,
Podocarpus sp.,
Podocarpus usambarensis,
Quercus craterophora,
Quercus bambusifolia,
Sterculia fœtida,
Salix sp.,
Spathelia simplex,
Thuja orientalis var. compacta,
Tococa platyphylla,
Xerospermum sp.

PALMS

Arikuriroba schizophylla,
Archontophœnix cunninghami,
Livistona australis,
Livistona jenkinsiana,
Orbignya martiana,
Thrinax floridana.

SHRUBS

Cassia splendida,
Cassia leptophylla,
Cordia sebestena,
Flemingia strobilacea,
Hibiscus Collinsii,
Malpighia punicifolia,
Solanum Wrightii.

CLIMBERS

Clematis chinensis,
Clematis filamentosa,
Clematis grata var. grandidentata,
Passiflora alata × cærulea.

THE WATERFALL GARDENS, PENANG

The principal change made in the Waterfall Gardens during the year was the removal of the plant-stand adjacent to the lower road, and the utilization of the flowering pot plants partly on the terrace of the new garden, where they show to much better advantage, and partly in making more showy flower beds in lawns B, D and E. The entrance to the formal garden was also improved by cutting back the hedge to show the ornamental gateway, and the lawn bordering the road between this gate and the main entrance planted with five beds of Cannas; this portion of road was also widened so that visitors wishing to enter the formal garden might conveniently park their cars. The Canna beds round the old bandstand were removed, being too near the spreading Podocarpus trees.

Composting has been carried out regularly on the lines recommended in the Department of Agriculture leaflet No. 17 (1937), and the resulting material has been found very useful both for herbaceous and woody plants. The latter have also benefited, as at Singapore, by application of rock phosphate as well as compost. The soil of the Gardens is very poor and sandy, and some of the woody plants in the upper lawns have made poor growth.

The collection of young plants of several species of Saraca has been moved from the upper end of lawn E, where they were too exposed, to a more sheltered position near the stream in lawn S. After being moved the plants made good growth, and should produce interesting flowering trees later.

In the new garden, growth generally was satisfactory. The climbers are now covering the pillars and are making some growth along the connecting chains. The herbaceous plants and small shrubs in the two long borders have developed into good compact groups giving a bright display of colour. A free-flowering variety of *Tecomaria capensis* was the most striking addition to the borders. A feature of the formal garden was a bed of *Plumbago rosea*, which flowered freely for more than four months, after which it was cut back. The best method of treating this shrub is to maintain about two inches thickness of a mulch of grass cuttings, which keeps the roots cool and acts also as an organic manure.

Several Poinciana trees remaining from the original row from the Gardens' entrance to the office were removed, as the avenue of *Mesua ferrea* is now well developed. A large Rambutan tree was also removed near the office. Several trees fell during the storms in August, when there were both high winds and heavy rains; the floods at this time, though unusually high both at the Waterfall Gardens and the Residency, did no permanent damage.

The clumps of thorny bamboo by the upper and lower bridges have died completely after flowering for more than a year. The clump by the middle bridge remains alive, without flowering. It has been found that these bamboos are *Bambusa arundinacea*, a Burmese species, not the Malaysian *B. Blumeana* as reported last year.

The numbering and cataloguing of trees in the gardens was completed and the card index of woody plants kept up-to-date. The herbarium of plants in the gardens was also re-arranged.

We express thanks to Dr. E. D. B. WOLFE of Sungei Patani for much assistance in the collecting of interesting plants, both for the garden and the herbarium. The most notable of these was the Petræovitex mentioned under *Field Excursions* above.

Buildings.—A new orchid house was constructed in the potting yard, size 26 by 15 feet, with open roof of laths, concrete floor and benches. The Public Works Department carried out the following works:—a new foot-bridge from lawn E to lawn H, an extension of the retaining wall below lower bridge, repairs to roof of plant-house No. 1, and a new water supply for the Gardens from the stream above the upper bridge. This last item has provided a supply of water in all parts of the Gardens even in the driest weather. The former supply from the smaller side-valleys often failed during drought when it was most needed, thus entailing much work in carrying water.

New Planting.—The following palms were added to the collection on lawn C:—*Arenga ambong, Actinorhytis calapparia, Borassus machadonis, Martinezia caryotæfolia, Oreodoxia regia, Pinanga sp., Rhopaloblaste hexandra, Thrinax parvifolia, Verschaffeltia splendida.* The following conifers were added to the collection on lawn J:—*Pinus Merkusii, Podocarpus Rumphii, P. usambarensis.* Other new planting included:—

TREES

Citharexylum quadrangulare,
Diospyros discolor,
Eugenia malaccensis,
E. pitanga,
Eriobotrya japonica,
Ficus Roxburghii,
Gustavia gracillima,
Millingtonia hortensis,
Michelia champaca,
Melaleuca hypericifolia,
Nephelium mutabile,
Saraca spp.

SHRUBS

Acalypha hispida,
Tecoma nilotica,
Thunbergia vogeliana,
T. ikballiana.

GOVERNMENT HOUSE DOMAIN AND OTHER OUTSIDE CHARGES

SINGAPORE

Government House Domain.—In addition to the usual routine maintenance work carried out in recent years, a special vote enabled certain improvements of the outlying parts of the Domain to be carried out. In the first place, all boundary hedges were re-dug and most were re-planted, and considerable additions made to the flowering trees in various parts of the Domain. A beginning was then made on a programme of levelling the rough areas of grass so that they may be mown with machines and thus maintained more satisfactorily. The areas adjacent to the main roads in the Domain were first dealt with, those parts not requiring to be levelled being dressed with fertilizers. It is hoped that when this programme is completed the whole of the Domain, with the exception of steep banks and gullies, will be mowable by machines, and the general neatness of the grounds considerably enhanced. There was a notable improvement by the end of the year, and the work is to be continued in 1939.

The gardens and nurseries at Government House were maintained as usual, with no considerable changes. The most striking feature of the garden beds was a display of *Begonia semperflorens*, which proved perfectly hardy in the full sun and flowered continuously for several months. *Hibiscus mutabilis* also made a fine show but only when very heavily manured. In the nursery, the stock of *Renanthera coccinea* has developed well and has begun to flower freely. In the vegetable garden trials were made of Sutton's Indian varieties of cauliflowers, namely Early Market and Early Patna. Both of these grew well, and at the end of the year over twenty heads of good quality had been cut. This is believed to be the first crop of cauliflowers of this kind produced in Singapore. Though the heads are not large, they are good and well worth growing. The plants benefit by protection from heavy rain. Two Avocado pear trees fruited well.

At the Colonial Secretary's House, the borders at the end of the tennis court were re-aligned and completely re-planted. At the Under Secretary's House a number of old and unsightly trees were removed, and new flowering shrubs planted.

Municipal Work.—The usual weekly reports on roadside trees were made to the Municipal Engineer. New planting was carried out in Thomson Road, Keng Lee Road, St. Andrew's Road and Lornie Road. Two further new kinds of trees were included, namely *Pometia pinnata* (of which there is a very fine old tree in the Botanic Gardens) and *Peltophorum dasyrachis,* which have made a good start. The new kinds first planted out in 1937 have mostly done well, notably the *Gardenia carinata* in Adam Road and the *Bauhinia monandra* in Changi Road. The *Dillenia ovata* in Adam Road have also grown well. In addition to new planting, a number of old trees have had to be removed. The municipal parks have also been regularly inspected and advice concerning maintenance provided.

PENANG

Municipal.—Regular inspections of roadside trees and parks were made as in former years. Reports were made and work supervised where necessary.

The Residency Garden.—The large clumps of thorny bamboo which had flowered and died were removed from the stream bank; other clumps continued to flower and will probably die also. Several willows were planted along the stream bank, and several groups of flowering trees in the area fronting York Road. Two tennis courts, one grass and one hard, were constructed by the P.W.D. The grass court was planted with a mixture of *Cynodon dactylon* and *Zoysia pungens*. *Stigmaphyllon lancifolium* was planted on the wire netting surrounding the courts.

General Hospital.—Old trees of *Melaleuca leucadendron* (Glam) were removed from Hospital Road and young trees of Poinciana, Peltophorum and Jacaranda put in their place. A new design for the layout of the quadrangle was prepared; a large number of beds were made, Cannas being planted along each side of the roadway, and elsewhere flowering shrubs. Flowering trees were spaced round the area, and Casuarinas planted in groups.

Hill Gardens.—The work for the year was principally maintenance, with one or two small improvements. At Strawberry Hill the railings were removed from the inner part of the garden, the design slightly altered and new beds planted. Climbing plants such as Congea, Allamanda and Ipomœa were planted to cover bare banks, and Cassias replaced two old "cherry" trees (Muntingia). A hedge of Bougainvillea was planted along the top of the bank above the railway station, another at Bellevue and a third at the Crag Hotel. These Bougainvillea hedges are very successful on the hill, being vigorous in growth and free-flowering. Further new planting of the local conifer Dacrydium elatum was carried out at Strawberry Hill and elsewhere. Experience has shown that this is likely to remain the most effective conifer for hill planting, but it is unfortunately slow in growth. The *Pinus Merkusii* trees between Convalescent and Fern Hill have continued to grow well and will soon make an attractive grove.

Advice was given concerning planting of trees near the hill railway. A considerable number have now been planted, and these will be followed by shrubs and climbers.

R. E. HOLTTUM,
Director of Gardens, S.S.

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STRAITS SETTLEMENTS

ANNUAL REPORT

OF THE

DIRECTOR OF GARDENS

FOR THE YEAR

1939

BY

R. E. HOLTTUM, M.A., F.L.S.,
Director of Gardens, S.S.

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ANNUAL REPORT OF THE GARDENS DEPARTMENT, STRAITS SETTLEMENTS, FOR THE YEAR 1939

STAFF

Mr. E. J. H. Corner, Assistant Director, was on leave until 26th April. Mr. J. C. Nauen, Assistant Curator, was on leave until 29th June, when he took over from Mr. J. W. Ewart charge of the work of the Department in Penang; Mr. Ewart then returned to Singapore and resumed duties as Assistant Curator in charge of the Singapore Botanic Gardens. Other members of the staff were on duty throughout the year.

On the outbreak of war, Mr. E. J. H. Corner was appointed Food Supply Officer, Singapore; Mr. M. R. Henderson (Curator of the Herbarium) and Mr. J. W. Ewart also devoted most of their time to the Food Supply Office from the outbreak of war until the end of the year.

Mr. C. X. Furtado, Assistant Botanist, qualified for the degree of Doctor of Science of Bombay University, having submitted a manuscript thesis on the history and present state of the systematics of Malayan palms, and also his published botanical papers on this and other groups. He actually received the degree after the close of the year.

LABOUR

The labour force remained approximately as in 1938, in the Botanic Gardens, Singapore, and the Waterfall Gardens, Penang, namely 85 and 50 respectively. In Government House Domain the labour force was increased to 74, in addition to 20 extra men for special work; and in the Waterfall Gardens, Penang, 9 extra men were also employed for nine months on special work (as reported below). On Penang Hill the labour force amounted to 29, and 11 men in the Residency grounds at Penang. Rates of wages were unchanged. Health was in general satisfactory.

REVENUE

The revenue from the sale of plants, seeds, etc. was as follows:—

	$	c.
Singapore:—		
Sale of plants and seeds	3,025	74
Inspection fees, etc.	876	25
Municipal contribution for Assistant Curator's services	2,400	00
Penang:—		
Sale of plants and seeds	561	90
Municipal contribution for Assistant Curator's services	1,200	00

PLANT COLLECTIONS AND FIELD EXCURSIONS

Owing to the absence of two senior officers on leave during the first half of the year, and special duties due to the outbreak of war during the last three months, less field work than usual was carried out.

Regular collections were continued in Bukit Timah Forest Reserve, by means of the trained Berok monkeys (*see* below), and much useful material obtained in this way. Some collections were also made in the

Kranji Reserve and in the Reservoir Jungle. After his return from leave, Mr. CORNER resumed his visits to south-eastern Johore, and a week's collecting was carried out in July near the Sedili River. Some interesting plants were found on the hill known as Tinjau Laut, east of the river. Mr. HENDERSON twice visited the neighbourhood of Pontian in south-western Johore; thanks are due to the Assistant Adviser, Pontian, (Mr. R. V. BRANT) for his assistance in making the necessary arrangements. One visit was to the island of Pulau Kemudi, in the Pulau Pisang group. The other visit was to peat forest, of which there is a considerable area remaining near Pontian. The flora was found to be similar to that of the forest formerly existing near the Jurong Road, Singapore, felled in 1932–33 and studied by Mr. CORNER. The peat forest of Pontian is also similar in many respects to the fresh-water swamp forest of S.E. Johore, but differs notably in the scarcity of the genus Eugenia.

In June, Mr. HOLTTUM paid a short visit to Sepang, Selangor, by invitation of Mr. F. C. FOGH of Teluk Merbau Plantations, Ltd., and collected some interesting plants in the coastal country. The neighbouring mangrove contains considerable quantities of orchids of the genus Arachnis; these are *Arachnis flos-aeris* var. *gracilis* (a small variety described some years ago from cultivated plants in Singapore) and several varieties of the natural hybrid *Arachnis Maingayi*. Plants of these have been collected and cultivated by Mr. FOGH. Another interesting plant discovered by Mr. FOGH is *Nepenthes trichocarpa*, growing under conditions which indicate clearly that it must be a hybrid between the common pitcher plants *N. gracilis* and *N. ampullaria;* the existence of such a hybrid was not formerly suspected. A single plant of *N. trichocarpa* was subsequently found at the Gap in Singapore. In August, Mr. G. H. ADDISON paid a week's visit to the forest in the neighbourhood of the Gap (F.M.S.) collecting herbarium specimens and also local plants (particularly Begonias) for cultivation. Mr. HOLTTUM took leave at Fraser's Hill over the Christmas holidays, and made some further observation on the local ferns, particularly of the difficult genus Diplazium.

Mr. C. X. FURTADO visited the Pontian district of Johore towards the end of the year, in connection with his study of Keladis (*see* below). He found 14 distinct varieties, some of them different from the Lower Perak collection made by Mr. E. F. ALLEN.

BOTANICAL RESERVES

The three Botanical Reserves in Singapore mentioned in the Annual Report for 1938 were finally gazetted as Forest Reserves during the year. This designation is for purposes of administrative convenience; the Reserves are primarily for the preservation of typical areas of natural vegetation, and control is entirely in the hands of the Gardens Department. For the purpose, the Director of Gardens is gazetted as a Conservator of Forests.

Regular patrols at Bukit Timah have reduced cutting of timber to very small proportions. Two arrests for timber cutting were made during the year. New growth in areas formerly devastated continued satisfactorily. Six arrests were made in the Kranji Reserve, where men were regularly employed in making a boundary path during a considerable part of the year.

At Bukit Timah, collection of specimens, and naming and labelling of trees continued. The numbered trees were increased to 440, but not all these have yet been identified. Nearly two miles of new paths were made in the Reserve during the year. The greater part of this was a boundary

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path, for convenience of patrol; the remainder (22 chains) a path connecting the new jungle pool to the North View Path. All paths were given name plates, and maps of the Reserve were placed in all the eight shelters. Clearings round the shelters were planted with grass, and some additional trees planted also.

The Berok collecting-monkeys were exercised daily in the Bukit Timah Reserve, and most of the specimens were obtained by their use. Mr. Corner purchased one further monkey after his return from leave. A full account of the use of the Berok monkeys for collecting specimens from trees was given in the Annual Report for 1937.

HERBARIUM WORK AND OTHER INVESTIGATIONS

Mr. Henderson and Mr. Furtado continued their usual work in the herbarium. The number of duplicate specimens sent out to other institutions (statement below) was less than usual; a number more were ready but not despatched on account of the outbreak of war. The number of specimens mounted and laid into the herbarium during the year was 8,348.

Mr. Henderson continued his work on the genus Eugenia, and had on loan much valuable material from the herbaria at Calcutta and Buitenzorg; to the Directors of these institutions we express our thanks for this assistance. Mr. Henderson also completed and published an illustrated account of his observations of the Limestone Flora of Malaya, in the Journal of the Malayan Branch, Royal Asiatic Society.

Mr. C. X. Furtado completed his account of the Malayan species of Homolomena, an interesting group of Aroids the nomenclature of which was much confused owing to lack of familiarity of previous authors with the variability of plants in the field. He also prepared a short paper on the variability of these plants and its relation to environmental conditions, for the 6th Pan-Pacific Science Congress (held at Berkeley, California). Mr. Furtado continued his study of the problems of the rules of nomenclature and prepared a series of recommendations to be considered by the next International Botanical Congress.

Mr. E. J. H. Corner completed the manuscript of his book on "The Wayside Trees of Malaya", and printing was begun during the year. This work deals with about 950 different trees, native and introduced, and still does not touch the majority of trees of primitive forest, which must number some 1,500 more species. Mr. Corner's book is based almost entirely on his own observations during the past ten years, and is the first considerable work on tropical plants which is based on field observations rather than on the description of dried specimens. It should be a most valuable aid and stimulus to the study of local plants. It will be very fully illustrated.

Mr. Holttum continued his observations on hybrid orchid seedlings, a number of which flowered for the first time during the year. Full records of these were kept, and are of especial interest, as in many cases first crosses between Malaysian species, never hybridized before, are concerned. Mr. Holttum also continued his notes on cultivated Bougainvilleas, and on the behaviour of deciduous trees in both Singapore and Penang. He went over the whole of the orchid herbarium of the late Mr. C. E. Carr, arranged for incorporation of all named specimens in the general herbarium, and sorted out a complete set of the extensive collections from Mt. Kinabalu for study by Dr. L. O. Williams of Harvard. Mr. Holttum also prepared a number of popular articles on gardens plants for the M. A. H. A. Magazine.

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A number of specimens for identification were received from Mr. G. H. SPARE, collected in the neighbourhood of Sungei Krian in Perak; Mr. SPARE also presented some interesting recent collections of mosses made by him in various parts of Malaya, and identified by Mr. H. N. DIXON.

During the month of February, Professor M. Burret of Berlin spent a few days in Singapore for the purpose of studying palms. Later, Captain H. JOHNSTONE also spent a month in Singapore and photographed many palms in the Gardens. Capt. JOHNSTONE has been of considerable assistance to us during several years in clearing up the identity of numerous cultivated palms.

Duplicate herbarium specimens were sent in exchange to other institutions as follows:—

Natural History Museum, Paris	245
Royal Botanic Gardens, Kew	236
Arnold Arboretum, U.S.A.	195
Forest Research Institute, Kepong	194
Imperial Forestry Institute, Oxford	175
Botanic Gardens, Brisbane	166
Botanic Gardens, Berlin	105
Bureau of Science, Manila	98
Forest Research Institute, Dehra Dun ...	86
Dr. Copeland, California (ferns)	9
Total ...	1509

The following material was sent on Loan to other institutions:—

University of California, for Dr. E. B. COPELAND (ferns)	142
Forest Research Institute, Kepong (Dipterocarpaceæ)	13
Total ...	155

The following duplicate specimens were received from other institutions during the year:—

Conservator of Forests, North Borneo ...	466
Rijks Herbarium, Leiden	186
Bureau of Science, Manila	100
Agricultural Officer, Krian (Mangifera) ...	9
Total ...	761

PUBLICATIONS

Volume X, Part 2 (completing Volume X), of the *Gardens' Bulletin, S.S.*, was published in August; it contained Mr. FURTADO'S paper on Homalomena (Araceæ), Mr. CORNER'S third series of Notes on the Systematy and Distribution of Malayan Phanerogams, Mr. C. F. SYMINGTON'S fifth series of Notes on Malayan Dipterocarpaceæ, and a short paper on the typification of *Rhus javanica* by Mr. FURTADO.

Volume XI, Part 1, of the *Gardens' Bulletin, S.S.*, was published in July, before Volume X, Part 2; it contained only a series of proposals by Mr. C. X. FURTADO for amendments to the Rules of Botanical Nomenclature.

The Director continued to edit the horticultural section of the *M.A.H.A. Magazine*, of which four issues appeared during the year; a number of articles on Malayan horticulture were contributed by the Director and other members of the Gardens staff.

Mr. FURTADO contributed four short papers on various aspects of botanical nomenclature to journals published outside Malaya.

Mr. M. R. HENDERSON'S paper on the Limestone Flora of the Malay Peninsula was published in the *Journal of the Malayan Branch, Royal Asiatic Society*, Volume XVII, Part 1, and was illustrated with photographs. It contained general notes on the limestone flora and a full annotated list of species so far collected on limestone in Malaya. The manuscript of Mr. E. J. H. CORNER'S book on "The Wayside Trees of Malaya" was completed and went to press during the year (*see* above, under the heading "Herbarium work and other investigations").

PLANTS OUTWARDS AND INWARDS

SINGAPORE :—	
Outwards:—	
Plants sold	6,242
Tubers, cuttings, etc. sold	6,215
Seeds sold (packets)	96
Plants, etc. supplied on exchange	698
Plants, etc. supplied free	4,954
Seeds sent to other botanical institutions on exchange (packets)	415
Inwards:—	
Plants, etc. collected by staff	146
Plants purchased	36
Seeds purchased (packets)	237
Plants, etc. received as gifts	170
Plants, etc. received on exchange	739
Seeds received on exchange (packets)	907
PENANG :—	
Outwards:—	
Plants	4,364
Seeds (packets)	37
Bulbs	1,455
Cuttings	2,315
Inwards:—	
Plants	624
Seeds (packets)	622
Bulbs	66
Cuttings	464

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Gifts of plants are gratefully acknowledged from the following:—Mrs. G. Beatty, Mrs. S. Q. Wong, Mr. J. Laycock, Madame Thavara Jaiyanta (Bangkok), Miss M. A. Buxton, H. H. Tungku Yacob (Kedah), Mrs. E. H. S. Bretherton, Mr. H. S. Whiteside, Mr. Mungo Park, Mr. J. S. Carey, Dr. E. D. B. Wolfe, Dr. W. J. Quaife, Mr. J. M. Jackson. Exchanges (chiefly of seeds) were effected with Botanic Gardens or similar institutions at Bonn, Bermuda, Basel, Berlin, Buitenzorg, Budapest, Barbados, Brussels, Cambridge, Copenhagen, Coimbra, Cienfuegos, Coconut Grove (Florida), Delft, Dresden, Dublin, Dehra Dun, Darwin, Edinburgh, Gothenburg, Greifswald, Hamburg, Hong Kong, Johore Bahru, Kew, Köln, Kaunas, Kirstenbosch (S. Africa), Lyon, Liege, Leipzig, Leiden, La Mortola, Leningrad, Montevideo, Madras, New York, Ottawa, Paris, Puerto Rico, Panama, Peradeniya, Rostock, St. Andrews, Stockholm, Tartu, Trinidad, Uppsala, Utrecht, Zagrab; also the U.S. Department of Agriculture, the Department of Agriculture, S.S. and F.M.S., the following nurseries:—Gem Nursery and Nam Kee Nursery (Singapore), Ellen Williams (Honolulu), Mount Elgon (Kenya), Bangkrabue Nursery (Bangkok); and the following persons:—Mr. A. Langloss (Bahamas), Mr. R. W. Jakeman (Labuan), Dr. O. Earp-Thomas (New Zealand), Mr. W. R. Holloway (Queensland), Mr. David Berry (Los Angeles), Mr. H. F. Barnes (Honolulu), Mr. M. G. Eber, Mr. H. Q. Levy (Jamaica), Mr. W. Frost, Dr. G. A. C. Herklots (Hong Kong), Mrs. Oswell (Mauritius), Mr. H. W. Simmonds (plant from Madagascar), Mr. J. L. Schofield (Queensland).

THE BOTANIC GARDENS, SINGAPORE

No major changes were made in the Gardens during the year. The chief feature of the year's work was the large number of new plants introduced by seed for trial from other Botanic Gardens. These included many Begonias, in which group Mr. G. H. Addison is taking a special interest, and also many succulents, which have proved of special value in connection with the development of the sun rockery at Penang.

Vegetable culture.—On the outbreak of war, a plot of 26 beds for vegetable culture was opened on lawn R. All vegetables were labelled, and a notice board adjoining showed a list of kinds which can be grown locally, with particulars of propagation and other information. This demonstration of the possibilities of locally grown vegetables aroused considerable public interest, and a number of requests for further information were received. In connection with this work, a number of short papers on local vegetables and their cultivation were prepared for the M.A.H.A. Magazine, in co-operation with the Agricultural Officer, Singapore. An attempt was made, in the demonstration plot and in the nursery, to grow all the kinds of vegetables which are most easily cultivated in Malaya. In addition, a few trials of unusual vegetables were made; among these, Sutton's "Early Market" and "Early Patna" cauliflowers proved successful, though the heads were not large.

Propagating material of vegetables was provided for the Gardens employees, who were encouraged to cultivate the ground round their quarters. Most of the ground available was put to this use.

A collection was made of all available kinds of edible aroids of the genera Colocasia, Xanthosoma and Alocasia, for a comparative study. The Agricultural Officer, Lower Perak, sent a complete set of varieties grown in his district. Varieties were also imported from Johore, Java and Calcutta.

There are discrepancies in the accounts of these vegetables in various books, and an attempt is being made by Mr. C. X. FURTADO to clear up the question of nomenclature.

Bougainvilleas.—The collection continued to grow satisfactorily, but the latest acquisitions have not yet flowered. By the end of the year, 21 varieties had flowered in the Gardens. Of the Calcutta hybrids, one received under the name "Mrs. Lancaster" has proved most successful. It is a soft magenta-pink, with large bracts, and has flowered very freely. A large *lateritia* hybrid of unknown origin, presented by Mr. C. E. WURTZBURG, also flowered well. Angle-iron tripod supports were provided to raise the larger Bougainvilleas, which thus show to advantage against a background of trees.

The Lake suffered towards the end of the year owing to drainage from part of the Tyersall camp being discharged into it. The drainage was subsequently diverted along the border of Tyersall Avenue. The result from a biological standpoint was interesting. Certain species of plants were entirely destroyed, and the conditions were for a time very unpleasant, but the final result was a great stimulus to the growth of the water-lilies, which ultimately made a fine display.

New Herbaceous plants.—The most notable new herbaceous plant raised during the year was *Lobelia dresdenensis,* which was very successful in pots and proved easy to propagate from both seeds and suckers; it is a pretty violet-blue, seedlings varying somewhat in shade. A number of trials of Melampodiums were made, and three distinct races selected for further trial, all superior to the original race of *Melampodium divaricatum* found in cultivation at Malacca.

Conifers.—The *Pinus Merkusii* on lawn D continued to make excellent growth, reaching about 18 feet. *Callitris intratropica* (from N. Australia), planted in August, 1938, attained more than 6 feet with a compact growth of an attractive bright green; this species may prove very useful for ornamental planting in Malaya. *Libocedrus macrolepis* var. *formosana,* planted in June, 1939, began to make good growth. It has an open habit, with attractive foliage. The columnar Cypress, *Cupressus sempevirens* var. *fastigiata,* planted in 1935, attained a height of over 12 feet; though this is a common sight in the hills of Java, it has probably never been seen before in the plains of Malaya. *Juniperus bermudiana,* planted 1938, has grown into a vigorous plant over 6 feet tall.

Rhododendrons.—The plants of *R. Brookeanum* and of *R. longiflorum* mentioned in the last report were unfortunately lost (except two of the former, sent to Penang Hill) but a large number of seedlings were successfully raised from *R. longiflorum.* These had attained almost to their full leaf size by the end of the year. Culture in pots, with a mixture of broken bricks and fern roots, proved successful, and exposure to full sun and rain finally possible.

Orchids.—The collection of orchid seedlings continued to make progress, and a good group of flowering hybrid Dendrobiums (chiefly *D. phalænopsis* × *undulatum* and *D. bigibbum* × *veratrifolium*) was on view throughout the year. *Vanda tricuspidata* hybrids began to flower during the year and proved strong growing, free flowering, attractive and quite distinctive in form, with a good rich colour. An Oncidium hybrid between *O. sphacelatum* and *O. flexuosum* also flowered well. Further seedlings of some of the second generation hybrids also flowered, and further selections were made of the crosses Vanda Cooperi × Marguerite Maron, Vanda Miss

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Joaquim × *V. Hookeriana,* and *Arachnis Maingayi* × *Hookeriana.* Propagation of the selected hybrids was continued. The first plants of a batch of seedlings of *Dendrobium leporinum* × *phalænopsis* flowered during the year. It is unfortunate that a large proportion of Arachnis-Vanda seedlings prove very shy of flowering and are thus useless, except possibly for further breeding.

New planting.—The following woody plants, largely of species new to the Gardens, were planted out during the year:—*Palms,* 33 plants of 20 different species; *Trees,* 71 plants of 46 species; *Conifers,* 10 plants of 8 species; *Shrubs,* 92 plants of 57 species; *Climbers,* 16 plants of 11 species.

THE WATERFALL GARDENS, PENANG

The usual maintenance work of the garden was continued, special attention being given to systematic cultivation and manuring of trees and shrubs. The labelling of plants was given special attention, and a considerable number of additional plants were labelled. The long borders in the new garden were completely replanted.

Storm damage.—A considerable amount of damage was done to the stream banks between lawns B and S, and the foot-bridge across the stream washed away during a very severe storm in May. The Public Works Department prepared plans for reconstruction, and supervised the work which was almost completed by the end of the year. Retaining walls were built confining the stream to a channel about 25 feet wide; filling and regrading of the slopes above the wall was followed by turfing, which was carried out by the Gardens Department. A new foot-bridge was built to replace the old one.

Rock Garden.—The terraced rock garden in lawn E was entirely reconstructed and extended to cover an area of approximately 1,000 square yards. This work and the reconditioning of the Fern Rockery was carried out by expenditure of a special item of $1,500.

The new garden was built in three irregular terraces. Each terrace was supported by a loose granite wall, and steps were made at appropriate points to connect a series of paths. The planting areas were irregular in shape, being defined by the walls and the curving paths. Before planting, these areas were deeply dug and a quantity of coarse granite filled in with the bottom soil to give good drainage, the top soil being mixed with leaf-soil, manure and sand. The new area was in part planted from the old, and in part by new plants of the genera Cereus, Opuntia, Euphorbia, Kalanchoe, Agave, Aloe, Adenium, Verbena, Salvia, Russellia, Hymenatherum, Zephyranthes, Pitcairnia, and orchids of the genera Vanda, Arachnis, Renanthera, Spathoglottis and Arundina.

Fern Rockery.—The reconditioning of the fern rockery was completed except for a small area near the stream. The whole area was cleared of unwanted palm and tree seedlings, forked and heavily top-dressed with leaf-soil and manure. The steps leading down to the rockery from the road were widened, the upper path regraded and a drain made all along it, and the steps leading to the bottom of the rockery reconstructed. The turf embankment beside the upper steps was replaced by a loose stone wall, in the crevices of which pitcher plants were planted. Numerous ferns and other suitable shade-loving plants were added to the general collection, the majority of these having been collected from the hill forest. The final result is a greatly improved growth of plants in the rockery, a more varied selection of plants, and better and more attractive access steps and paths.

New planting.—The most interesting items of new planting (of woody plants) were as follows:—*Couroupita guianensis* (cannon-ball tree) and white Champaka in lawn C; four species of Casuarina and two of Erythrina in lawn E; new Cassias in lawn O; eight species of palms and a number of interesting shrubs in lawn T.

Buildings, etc.—The Public Works Department undertook the following works:—reglazing the two small propagating houses in the nursery, re-roofing plant houses Nos. 8 and 9, and minor repairs to the roofs of plant houses 5 and 6. Gardens seats were fixed at selected places in the grounds, and seven new seats, made by the Government Trade School, were placed in the new garden.

GOVERNMENT HOUSE DOMAIN AND OTHER OUTSIDE CHARGES

Singapore

Government House Domain.—The improvements in the Domain begun in 1938 were continued by expenditure of a second special vote of $5,000, and the usual maintenance work increased by an addition to the annually recurring vote. Twenty extra men were employed throughout the year, and the special vote also covered lorry hire for transport of earth, turf, etc., and purchase of fertilizers and some necessary tools. The chief work carried out by this additional labour was the re-grading and re-turfing of the very rough ground in the portion of the Domain sloping down towards Bukit Timah Road. By the end of the year almost the whole of this side of the Domain, previously rough, unsightly and difficult to deal with, was a smooth sward of Serangoon grass which could be maintained in good order by motor mowers. The grass areas dealt with in 1938 were also given further attention and fertilizing in 1939. In the two years 1938–39 almost the whole of the outlying parts of the Domain received special treatment, and the general improvement in appearance was considerable.

New trees and shrubs were planted as follows. Near the main entrance, a group of Wormia to screen the canal, and also 3 willow trees, 1 *Cæsalpinia ferrea*, 3 Poinciana and 4 Bougainvilleas. Near the Malay Burial Ground, 4 Tembusu, 5 Spathodea and 7 other trees. In the north-eastern area (*a*) 5 Bamboos and 5 Bougainvilleas, (*b*) 3 *Cassia spectabilis*, 1 *Pometia pinnata* and 11 flowering shrubs near the filter beds, (*c*) 2 *Cassia spectabilis*, 2 Cinnamons and 6 Plumerias facing Mackenzine Road. Near road to Nursery, 6 Conifers and 9 *Tecoma stans*. Behind Government House, 3 *Cassia fistula* and 3 other trees. On upper lawn facing House, 1 *Cæsalpinia ferrea*. Near golf Green No. 3, 1 *Lagerstrœmia Loudoni*. Seventeen old, unsightly or dangerous trees were removed.

After the outbreak of war, a new vegetable plot of 38 beds was opened in addition to the former nursery accommodation for this purpose. The following vegetables were grown:—Long beans, French beans, Sweet Potatoes, Radishes, Cauliflowers, Lobak, Maize, Brinjals, Lettuces, Artichokes, Lady's fingers, Amaranthus, Chinese Cabbage. A vegetable garden was also made below the Colonial Secretary's house.

Municipal Roadside Trees and Parks.—Weekly reports on Roadside Trees were submitted to the Municipal Engineer throughout the year. The number of new roads being made in Singapore offers scope for a variety of new planting, and some new kinds of trees have been introduced, not previously used locally for avenue work. Altogether 658 trees were planted during the year. As against this, 188 old and decayed trees, considered

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dangerous or unsightly, were removed; these were replaced by new trees where possible. The new kinds used were *Melaleuca leucadendron* (Gelam), *Tamarindus indica* (Asam), *Cassia spectabilis* (a recently introduced tropical American species which has made very vigorous growth and flowers well), *Kurrimia paniculata* (the Malayan spindle tree), *Pygæum polystachyum*, *Rhodamnia trinervia* (Mempoyan), and *Melia azederach* (Persian Lilac). All but the last were very successful. Rhodamnia trees, which are slow, were interplanted with quick-growing Acacias. In addition to these, the use of species formerly planted was continued. The Eugenia trees in Connaught Drive, planted in 1925 in case of failure of the Rain Trees (which were seriously attacked by an insect pest), were removed, as the Rain Trees had recovered and the Eugenias interfered with their growth.

Reports on parks were submitted periodically to the Municipal Architect. In Jubilee Park about 250 trees and shrubs were planted; in Farrer Park various unsatisfactory trees were replaced and Canna beds planted round the tennis courts. Reports on work to be done at Mt. Emily were also submitted.

Other Work.—Advice was given and plants supplied in connection with planting round various Government buildings. Advice was also given in connection with the supply of a considerable number of trees and shrubs for planting by the defence services in various parts of Singapore Island.

PENANG

Municipal.—Inspection work of Roadside Trees and Parks was carried out as in former years, and reports submitted to the Municipal Engineer.

Residency.—General maintenance of the Residency grounds was continued. The orchid garden was replanted, and the border of mixed orchids rearranged. The bedding on the terrace was also renewed and the grouping of plants changed. The gaps made by the death after flowering of the thorny bamboos were filled by the species *Thyrsostachys siamensis*. Trees and shrubs were also planted in the outer part of the grounds.

Penang Hill.—The gardens at Bel Retiro, Crag Hotel, Strawberry Hill and the five Government Bungalows were maintained as usual, special attention being given to improvements of bedded plants. At Bel Retiro, a number of conifers had to be removed; some of these were old Dacrydiums and the others Cupressus trees which were raised from Ceylon seed a few years ago. The latter have proved unsuitable for general planting on Penang Hill, being short-lived and also very variable in habit. The trees removed were replaced by Dacrydiums and also *Podocarpus Rumphii* and *P. usambarensis* (from E. Africa).

General Hospital.—A further section of planting of the grounds at the General Hospital was undertaken under the guidance of the Gardens Department.